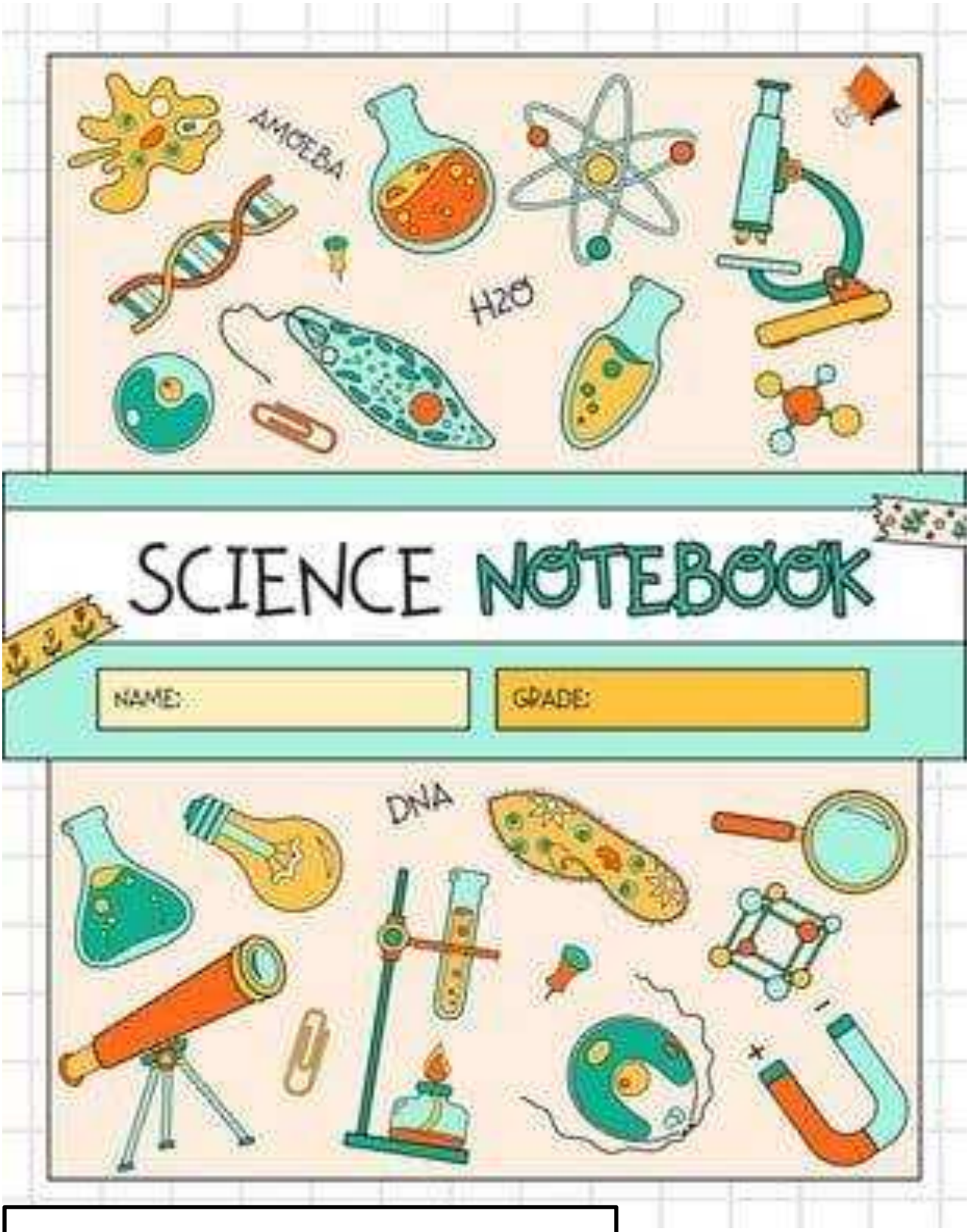

Prep 1

First term 2025\ 2026

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Unit 1

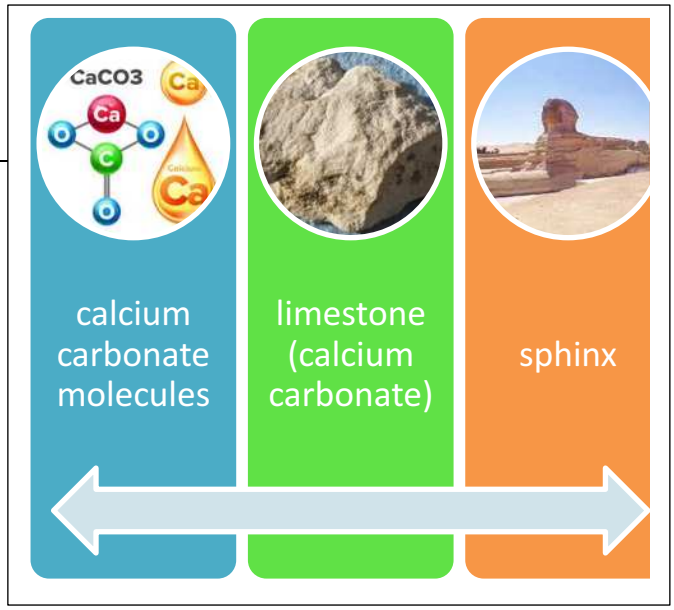
lesson 1

Structure of the Atom

Matter: anything that has mass and volume

Atom: it is the building and structure unit of the matter

N.B: molecule consists of atoms



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*The greek philosophers believed that the matter was formed of small indivisible parts are called (**Atom**)

*in 19th century **Dalton** proposed the 1st atomic theory that (atom are indivisible)

*in 1909 **Rutherford** proposed the 1st model of Atom based on experimental basis

N.B: **Ernest Rutherford** won nobel prize in chemistry , new zealand honored him by putting his image on its largest currency

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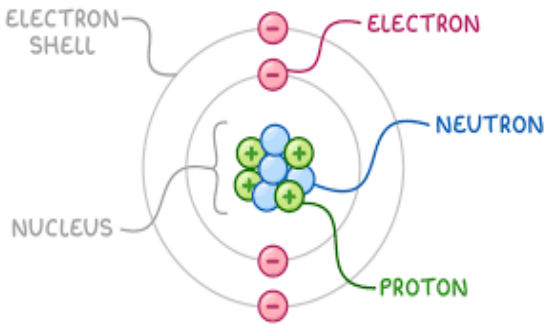
Atom: it consists of **nucleus** and surrounded by **electrons**

Nucleus: tiny space in atom and has 2 typed of particles **protons** and **neutrons**



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Electrons: are very small particle revolve around the nucleus at very high speed in certain energy level

Subatomic particles

particle	symbol	Relative electrical charge	mass
Proton	P positive	+	1 u
Neutron	N neutral	0 (±)	1 u
Electron	e^- electron	–	1\1836

N.B:

1) Proton charge = electron charge in the magnitude but opposite in the type

2) The nucleus of the Atom is positively charge (G.R)

Because it contains positive protons and neutral neutrons

3) Their mass is measured in the atomic masses unit (u)

4) Protons mass = neutrons mass

5) The mass of the atom is concentrated in the nucleus (G.R)

Because the mass of the electrons is negligible and very tiny compared to the mass of protons and neutrons

Chemical symbols of elements

*Element symbol represent a single atom

** we take the 1st letter or 2 letters if the English name and Latin name are the same

***If the English and Latin names are different we symbolized according to Latin

* the 1st letter must written capital and the 2nd letter is small

symbol	English	Latin
C	Carbon	Carbo
N	Nitrogen	Nitrogenium
Cl	Chlorine	Chlorum
Cr	Chromium	Chromium
Na	Sodium	Natrium
K	Potassium	Kalium
Cu	Copper	Cuprum
Fe	Iron	Ferrum

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Symbols of some Elements

Element	Symbol
Hydrogen	H
Helium	He
Mercury	Hg
Oxygen	O
Fluorine	F
Phosphorus	P
Lead	Pb
Sulphur	S
Silicon	Si
Aluminium	Al
Gold	Au

Element	Symbol
Potassium	K
Magnesium	Mg
Lithium	Li
Zinc	Zn
Neon	Ne
Beryllium	Be
Bromine	Br
Iodine	I
Argon	Ar
Boron	B
Silver	Ag

Fertilizers: chemical compound that are used to improve the agricultural production

The most important types of fertilizers is **NPK Fertilizers**

N: Nitrogen

Essential for green plant leaves

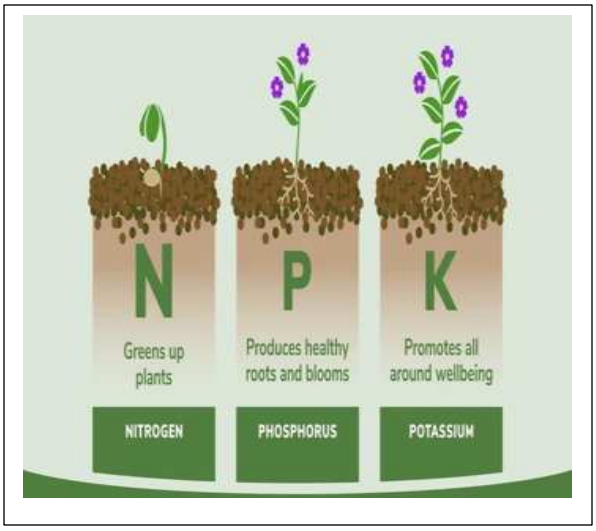
P: Phosphorus

Essential for the strengthening of plant roots

K: Potassium

Essential for healthy plant growth

<u>Excessive use of fertilizers</u> is harmful to plant, soil, human and animals health



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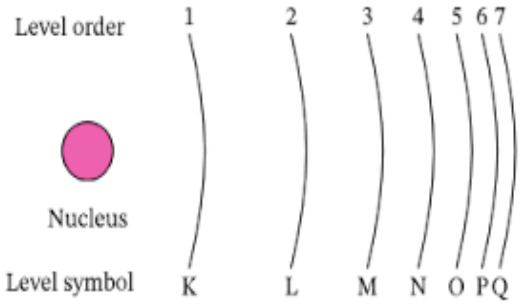
Energy levels

Electrons revolve around the nucleus in 7 main energy levels (according to its energy)



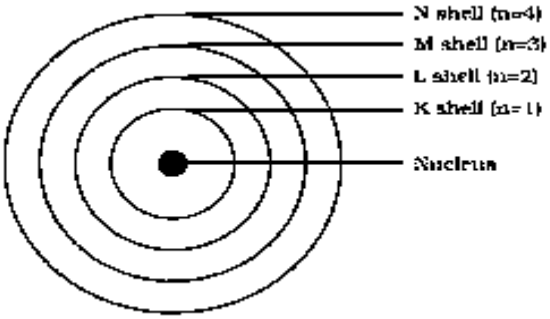
The 1st 4 energy levels can be saturated with definite number of electrons. Determined by ($2n^2$)

N.B:1) the energy of electrons increases as they move farther from the nucleus

2) As the distance increase the energy difference between levels decrease

EX: The energy difference between **L** and **M** is less than **K** and **L**

energy level	no. of energy level	no. of electrons
K	**1**	2×1^2=**2e**
L	**2**	2×2^2=**8e**
M	**3**	2×3^2=**18e**
N	**4**	2×4^2=**32e**



Electronic configuration

Rules for Electronic configuration:

1) 1st energy level filled first then the next one
2) The outermost (last) energy level does not contain more than **8** electrons **Except** the 1st energy level **(k)** is saturated by **2** Electrons **only**

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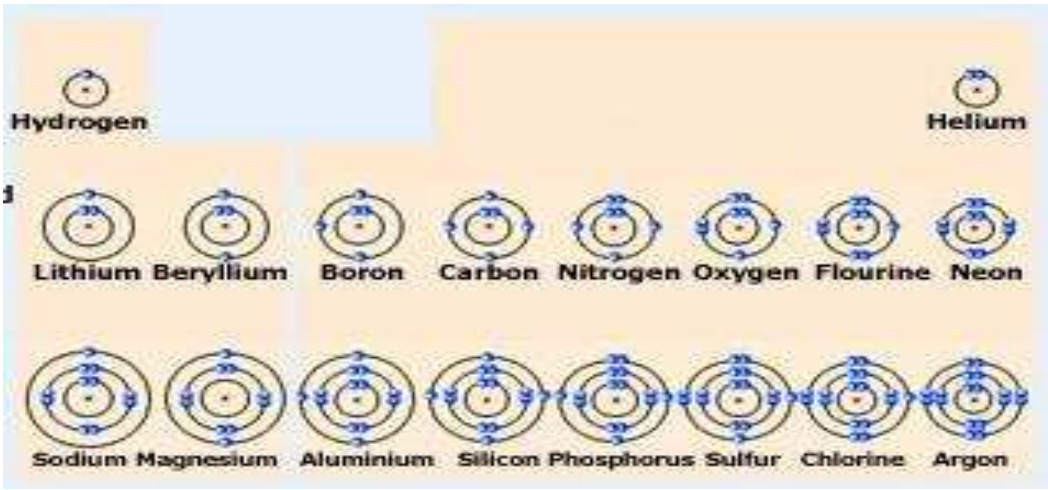
Examples:

Write the electronic configuration for:



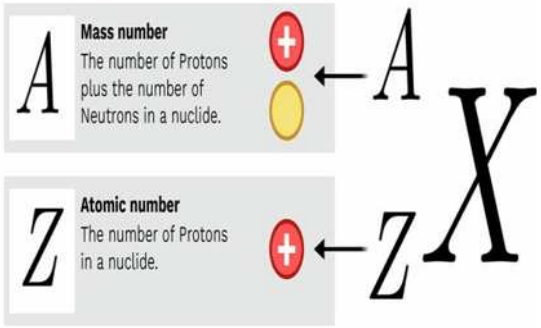
1) Oxygen (O_8) …… **3) Potassium (K_{19}) ……**

2) Beryllium (Be_4) …… **4) Helium (He_2) ……**

Relationship between numbers of subatomic particles

1) **The Atom is electrically neutral (G.R)**
   As the Number of positive protons = Number of negative Electrons
2) **Atomic number (Z)** is the number of positive protons found inside nucleus
   Written at the **lower** left side of the element symbol
   ***neutrons =protons** such as Helium and carbon
   ***** **neutrons > protons** such as Boron, Beryllium and Lithium
3) **Mass number (A)** the sum of number of protons and neutrons inside the nucleus
   Written at the **upper** left side of the element symbol

Elements	No. of protons	No. of electrons	No. of neutrons	Protons + neutrons
Hydrogen H^1_1	1	1	0	1
Lithium Li^7_3	3	3	4	7



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Isotopes: are different forms of the same element's atoms that have the same **atomic number** but different **mass number**

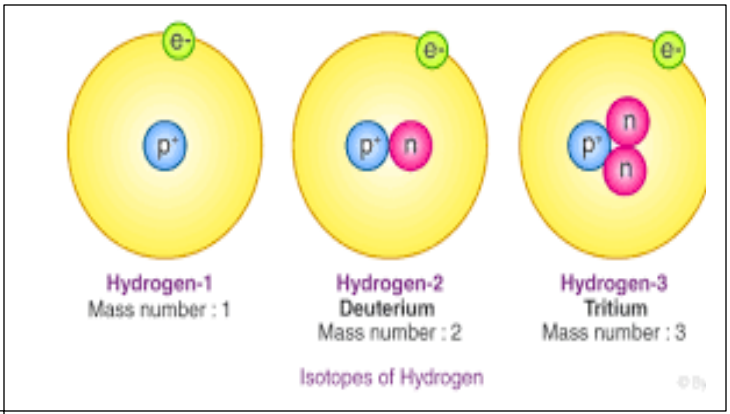
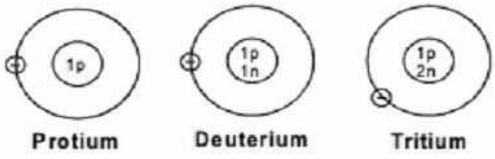


Table Isotopes of hydrogen

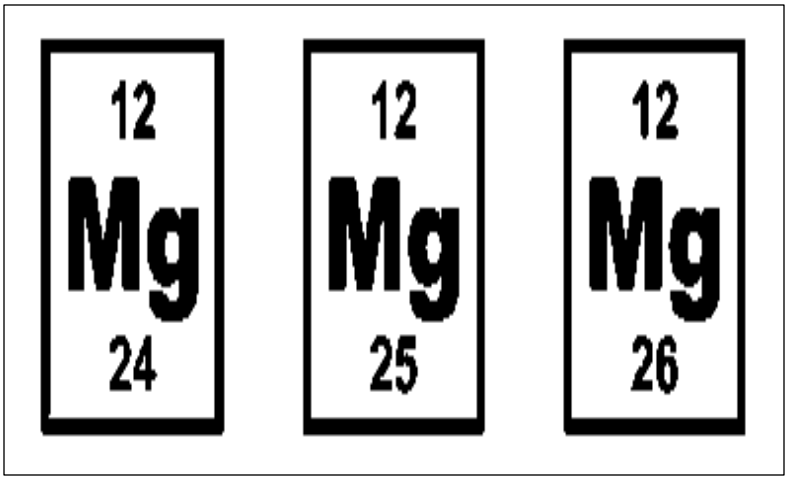
S. No	Name	Symbol	Atomic number	Mass number	Number of	
					Pro-tons	Neu-trons
1.	Protium or hydrogen	$_1H^1$	1	1	1	0
2.	Deuterium or heavy hydrogen	$_1H^2$	1	2	1	1
3.	Tritium	$_1H^3$	1	3	1	2



Hydrogen is the simplest element in nature, has 3 isotopes

1) **Protium** does not contain neutrons??
   As atomic no. = mass no.
2) **Deuterium** protons = neutrons
3) **Tritium** protons half neutrons

Magnesium has 3 isotopes



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Exercise

Choose the correct answer for questions:

1) **What is the subatomic component that has the smallest mass?**

a) Nucleon. b- Electron. C- Neutron d- Proton

2) **The nucleus of potassium atom contains 19 protons, then the electron with the highest energy in this atom is found in the……**

a. second energy level. c. first energy level.

b.third energy level. d. fourth energy level

3) **Each of the following is matter, except……..**

a. light. b. table salt. c. sand. d. air.

4) **The mass of a proton equals……**

a. 1 mg b. 1 kg c. 1 u d. 1g

5) **Which of the following represents an element and its correct symbol…….**

a. Chromium Cr b. Nitrogen Ni c. Phosphorus F d. Potassium P

6) **The number of negatively charged particles in aluminum atom $^{27}_{13}Al$ is……**

a. 20 b. 13 c. 27 d. 14

7) **The last energy level contains 7 electrons in the atom of……**

a. $_{15}P$ b. $_{9}F$ c. $_{11}Na$ d. $_{7}N$

Write the scientific term of each of the following statements:

1. **A subatomic particle whose charge can be neglected, but its mass cannot be neglected. (…….)**

2. **The sum of the number of protons and neutrons that compose the nucleus atom. (…….)**

Give Reason for:

1) **The nucleus of an atom is described as positively charged**

……..

2) **The mass of an atom is concentrated in the nucleus**

……..

3) **The atom is electrically neutral**

……

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Lesson 2

The periodic table of Elements

Attempts to classify Elements

to facilitate their study and to conclude relations between elements and their chemical and physical properties

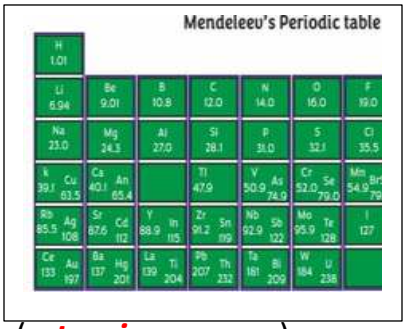
The most important attempts

1) Mendeleev's periodic table

2) Moseley's periodic table

3) The modern periodic table

Mendeleev's periodic table



* it is the 1st true periodic table

Dmitri Mendeleev Russian chemist, published his periodic table 1869 and later modified, he honored by naming one element after him (Mendelevium)

1) He arranged the elements in ascending order according to their(***atomic masses***) without consistent regular pattern (from left to right) horizontal (period)
2) Discover that the properties of elements repeat periodically with the start of each new row

---

Moseley's periodic table

* **Rutherford** discover that the nucleus of atom contain positive charged protons

* **Moseley** discover that periodicity of element properties is related to their **atomic number** not their **atomic masses**

1) Arranging elements in ascending order according to their atomic numbers

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2) **He added to the table:**

1) the group of inert gases (helium-neon-argon…….)

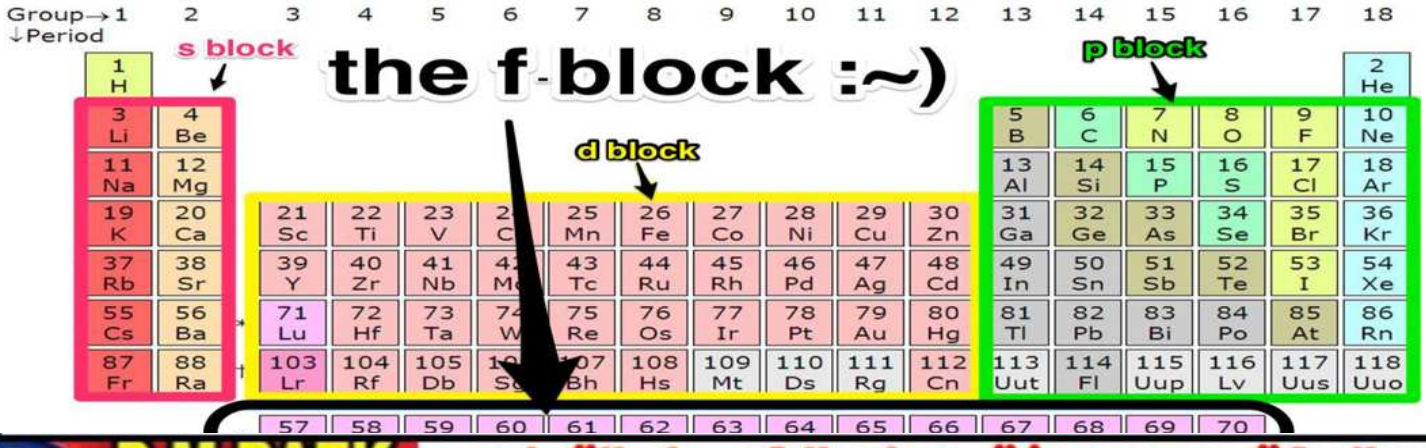
…r elements that discovered after Mendeleev

3rd Modern periodic table

- The elements are Rearranged in a new table, in a regular Ascending order based on
  1) The atomic number
  2) The method of filling energy sub-level with electrons

- The modern periodic table includes **118 Elements**
- Consists of **7 horizontal periods** each start with a new energy level and **18 vertical groups** with a traditional numbering as well as a modern numbering
- Elements of the periodic table are classified according to the **physical state** into:

Solid elements	Liquid elements	Gaseous elements
Most of elements of the periodic table	**2** elements only	**11** elements * 5 **nonmetal** * 6 **inert gas**
Lithium **sodium** **carbon** **iron**	**Mercury** (metal) **Bromine** (non-metal)	**Non-metal** (hydrogen, nitrogen, oxygen, fluorine, chlorine) **Inert gas** (helium, neon, argon, krypton, xenon, radon)



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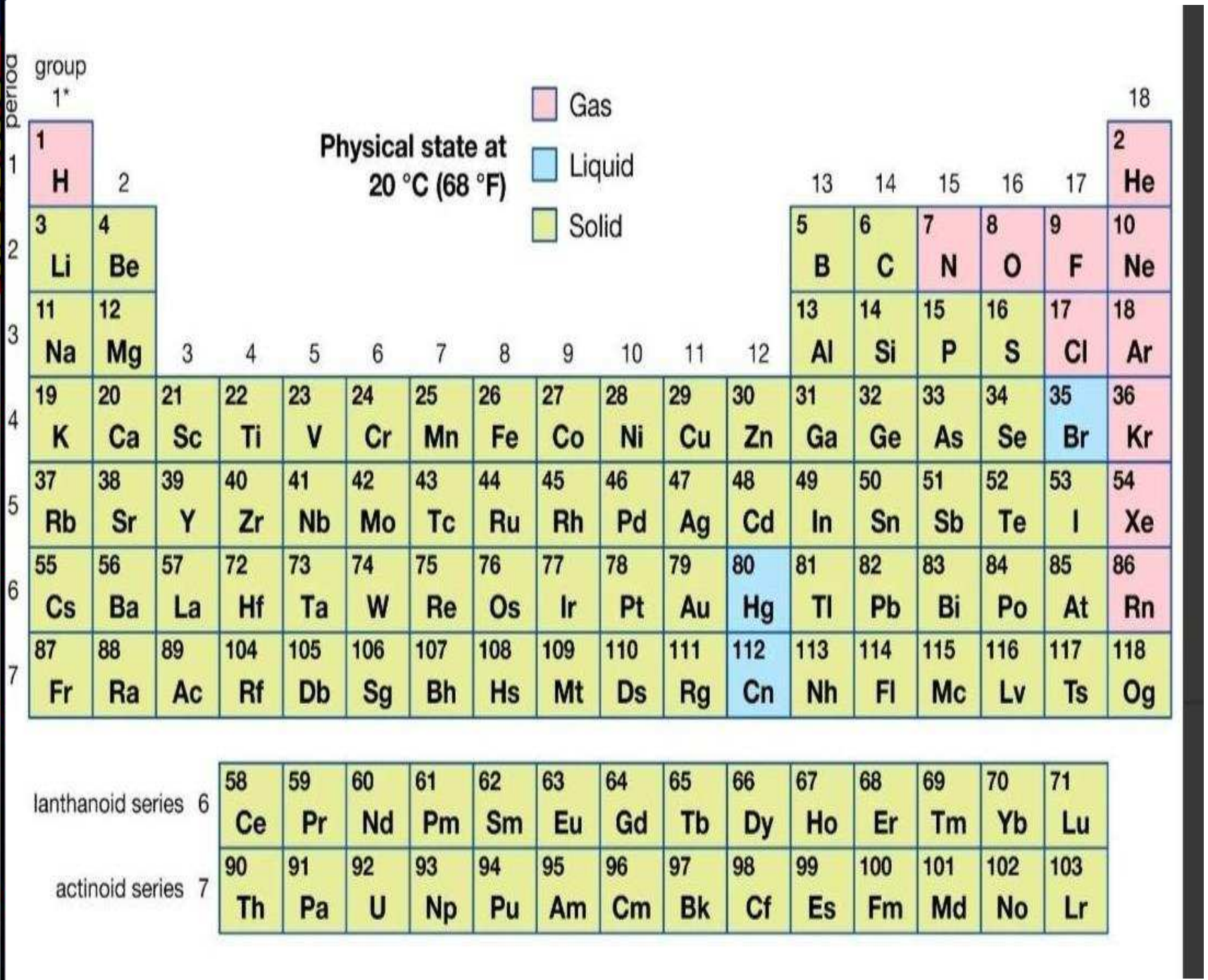


Four Main blocks:

1) s-block 2) p-block 3) d-block 4) f-block

1) S-block:

* located at the **left side**

* consists of **2 groups** labeled with letter **A**

1) group 1A: they all metals **except Hydrogen**, known as **Alkali metals**

their electron configuration end with **1 electron**

EX: lithium 2, 1 sodium 2,8,1

2)group 2A: they are all metals, known as **alkaline earth metals**

their electron configuration end with **2 electrons**

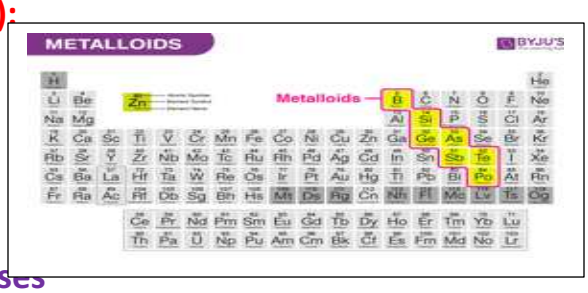
EX: Beryllium 2,2 magnesium 2,8,2

2) P-block:

* located at the **right side**

* consists of **6 groups** labeled with letter **A Except group(0)**

1) **penultimate group 7A elements (before the last):**



they are nonmetals

they are known as **halogens**

their electron configuration end with **7 electrons**

EX: fluorine 2,7 chlorine 2,8,7

2)**last group (0) elements**: they are **noble (inert) gases**

their electronic configuration end with **8 electrons** Except **Helium** end with **2 electron**

EX: Neon 2,8

N.B:

P-block elements include :

1) **all non-metals** whose electron configuration mostly end with 5,6,7 electrons

EX: phosphorus 2,8,5 Nitrogen 2,5

2)**all nobel gases** EX: Argon 2,8,8

3) **some other metals**

EX: Aluminum 2,8,3

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4) **all metalloids** cannot be identified by their electron configurations Due to the difference in the number of electrons in their outermost energy levels

3) d-block elements:

It occupies the **middle** of the periodic table

Its elements are all **metals.**

They begin to appear in **period (4)**, and they are called **transition metals.**

4) f- block:

-It is located at the **bottom** of the periodic table.

Its elements are all **metals.**

N.B: 1) Most metals have a electron configuration ends with **1,2,3 electrons**

Most non-metals have electron configuration ends with **5,6,7 electrons**

Noble gases have electro configuration ends with **8 electrons** Except Helium **(2 electrons)**

2) Elements of the **same group** are similar in the **number of the electrons** found in the last energy level

3) Elements of the **same period** are similar in the **number of the energy level** occupied by electrons

---

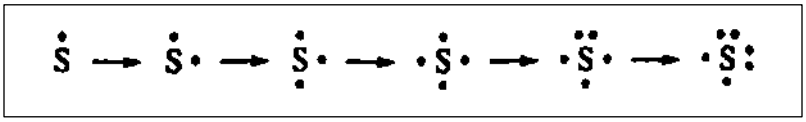
Lewis Dot Structure for Valence Electrons:

_The scientist Lewis proposed a simplified method to represent the number of the electrons which are found in the last energy level around the element symbol, known as **valence electrons**, using dots (.)

_which are distributed on the four sides of the element symbol, individually (singly) first, and then they are paired up until they are distributed completely

_It is possible to conclude the valency of an element from the number of the unpaired (single) electrons in its Lewis structure.

* number of unpaired electrons=2
* sulphur is **divalent**



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The valencies of elements in **groups 1A: 4A equals the group number**.
The valencies of elements in **groups 5A: 0 equals:**

(8-the number of last energy level electrons)

• The valency of the noble gases equals zero **... G.R.?**
Because the last energy level in each of their atoms
is completely filled with electrons, and their Lewis dot structure doesn't contain unpaired electrons.

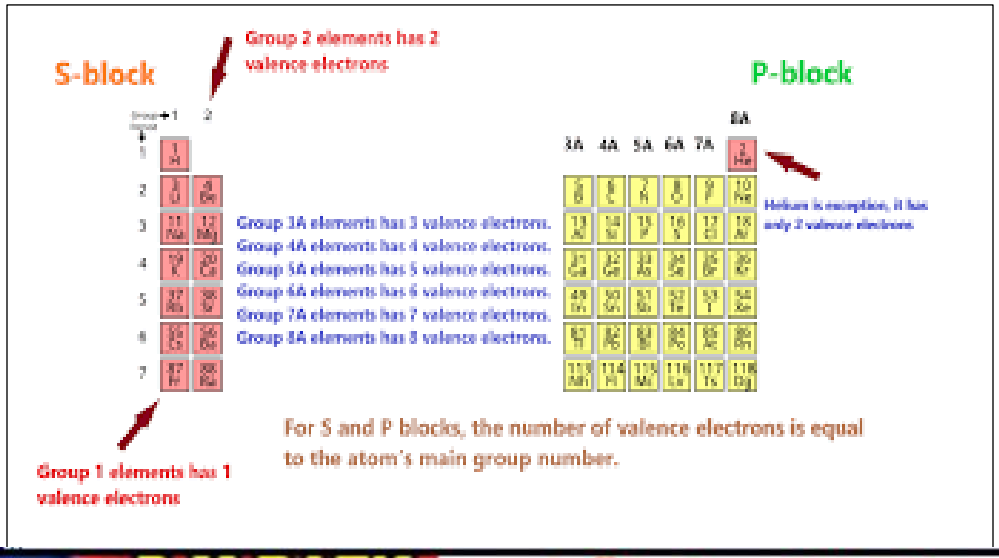
Group number	1A	2A	3A	4A	5A	6A	7A	0
Element	Li	Be	B	C	N	O	F	Ne
Valency	Monovalent	Divalent	Trivalent	Tetravalent	Trivalent	Divalent	Monovalent	Zero

---

Determine the Atomic Numbers of Group A Elements Based on Their locations in the Periodic

1.The number of energy levels occupied with electrons in the element atom **based on Period number of the element**

2. The number of electrons in the last energy level in the element atom **based on Group number of the element (according to traditional numbering) Table**


S-block
Group 2 elements has 2 valence electrons
P-block
Group 1A elements has 3 valence electrons.
Group 4A elements has 4 valence electrons.
Group 5A elements has 5 valence electrons.
Group 6A elements has 6 valence electrons.
Group 7A elements has 7 valence electrons.
Group 8A elements has 8 valence electrons.
Helium is exception, it has only 2 valence electrons
For S and P blocks, the number of valence electrons is equal to the atom's main group number.
Group 1 elements has 1 valence electrons

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N.B:

*** In the same period in the modern periodic table**

the atomic number of an element exceeds that of the preceding element by 1

*** In the same group of (periods 2 and 3) in the modern periodic table**

the atomic number of an element exceeds that of the preceding element by 8

*** There are no elements between sulphur and chlorine**

as their atomic number is integer number

The Electron Configuration of Atoms Reveals Their Properties:

Chemical properties of elements depend on the number of the electrons in the outermost energy level in their atoms, while differences in the number of neutrons in their nuclei result in differences in some physical properties.

Some physical properties of some alkali metals and halogens:

Alkali Metals	Atomic radius	Melting point	Boiling point	Halogens	Atomic radius	Melting point	Boiling point
Lithium $_{3}Li$ 2,1	157 pm	181°C	1347°C	Chlorine $_{17}Cl$ 2,8,7	99 pm	-101°C	-34°C
Sodium $_{11}Na$ 2,8, 1	191 pm	98°C	883°C	Bromine $_{35}Br$ 2,8,18,7	114 pm	-7°C	59°C
Potassium $_{19}K$ 2,8,8,1	235 pm	64°C	774°C	Iodine $_{53}I$ 2,8, 18, 18,7	133 pm	114°C	184°C
	increases	decreases	decreases		increases	increases	increases
	By increasing the atomic number				By increasing the atomic number		

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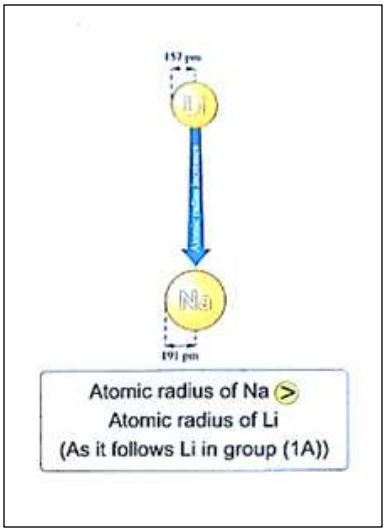
N.B:

(1) The atomic radii of elements in the same group:

the atomic radii of elements in the same group **increase** as the atomic number increases (from top to bottom in the group).



(2) Melting and boiling points in:

A- Alkali metals:

The melting and boiling points of alkali metals decrease as the atomic number increases (from top to bottom in the group).

B- Halogens:

The Melting and boiling points of halogens increase as the atomic number increases (from top to bottom in the group).

the relation between the physical state of a substance and its melting and boiling points relative to room temperature (25°C)

The physical state of substance	Melting point °C	Boiling point °C
Solid	More than 25°C	
Liquid	Less than 25°C	More than 25°C
Gas	Less than 25°C	

N.B:

1.The melting and boiling points of lithium and potassium are higher than room temperature.

Because both are solid elements at room temperature.

2.The melting and boiling points of chlorine are lower than room temperature

Because it is a gaseous element at room temperature.

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(3) Chemical Activity:

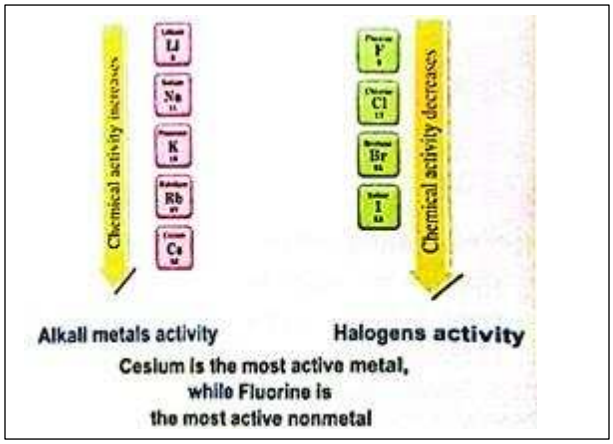
A. In the two groups of Alkali and Alkaline Earth Metals:

*The chemical activity of metals increases with increasing the atomic number (from top to bottom in the group).

*Alkaline earth metals are less active than that of the highly active alkali metals.

B. In the Group of Halogens:

The chemical activity of nonmetals decreases with increasing the atomic number (from top to bottom in the group).



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Exercise

Choose the correct answer:

1) **The alkali earth metals are located in the…… of the periodic table.**
   a. left b. right c. middle. d. bottom.
2) **The zero group in the modern periodic table belongs to……**
   a. s-block. b) p-block. C) d-block. d) f-block.
3) **The zero group includes…….**
   a. metals. B) liquid nonmetals. C) metalloids. D) inert gases.
4) **……..is a solid halogen.**
   a. Fluorine b) Chlorine c)Bromine d) iodine.
5) **The elements of the (d)-block are known as……..**
   a. inert elements. b) transition elements. c) alkali metals d) alkaline earth metals.
6) **The atomic number of the inert gas which is located in the 2nd period is……**
   a. 2 b) 8 c) 10 d) 18

Write the term that indicates each of the following statements:

1) **Scientist who arranged the elements in his table in ascending order according to their atomic masses (…….)**
2) **A scientist who added the zero group to Mendeleev's periodic table. (…….)**
3) **The only liquid metal in the modern periodic table. (…….)**
4) **The most chemically active element in group 7A (…….)**
5) **The noble gas whose Lewis structure includes 2 unpaired electrons. (…….)**

What is the atomic number of each of the following elements:

1. **An element that is located in period 2, group 6A** ……
2. **An element that is located in period 3, group zero.** ……
3. **An element that is located in period 1, group zero.** ……

Give reasons for each of the following:

1) **Sodium is an alkali metal**

……

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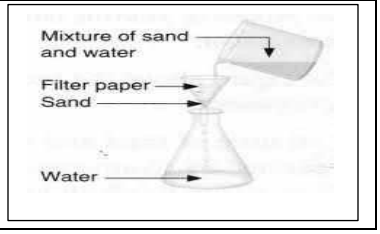
Unit 1

Lesson 3 Matter and its properties

Substances are classified into:

Mixtures	Pure substance
they are substances that composed of 2 or more materials that are not *chemically combined* and can be separated by physical methods **physical methods:** 1)magnetic separation 2) filtration 3) evaporation and condensation	They are substances whose components cannot be separated by the physical methods.

Classified into

Homogeneous mixtures (solutions)	Heterogeneous mixtures
Mixture that their components **cannot** be distinguished by the naked eyes	Mixture that their components **can be** distinguished by the naked eyes
Examples Table salt solution	**Examples** Sand in water mixture
Can be separated by Evaporation and condensation: used to separate solid that dissolved in water	Can be separated by filtration: used to separate solid which is not dissolved in water by using filter paper in filtration funnel
	

Classified into

Elements	Compound
It is the simplest pure form of matter and cannot be dissociated into simpler forms, either by physical or chemical methods	It is a pure substance formed by the chemical combination of two or more elements in a fixed mass ratio.
Examples Oxygen mercury	**Examples** water mercury oxide
Molecules of element 1) Monoatomic carbon (C) 2) Diatomic oxygen (O_2) 3) Polyatomic ozone (O_3)	

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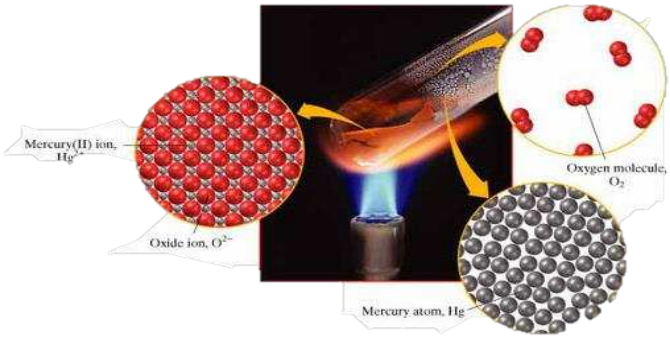
Chemical Separation Methods of Compounds

1. Heating	2. Electrolysis
When mercury oxide (red) is heated, it decomposes into its elements (mercury and oxygen gas).	When water acidified with sulphuric acid is subjected to electrolysis using a **Hoffmann voltameter**, it decomposes into its elements (hydrogen and oxygen gases).



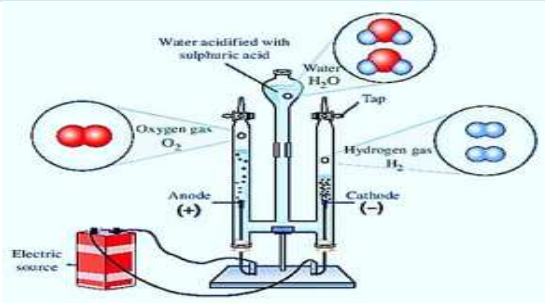
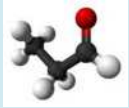
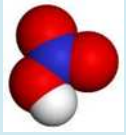
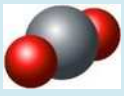


Figure (3) Electrolysis of water

Molecular formula: A symbolic formula that expresses the type and number of atoms of the elements that form the molecule.

Classification of Compounds:

Organic Compounds (Carbon compounds)			Inorganic Compounds	
Organic Compounds Compounds in which carbon atoms are bonded mainly to hydrogen atoms and may also be bonded to other atoms such as oxygen and nitrogen			Inorganic Compounds Compounds which contain various elements, including carbon in some cases.	
Examples:			**Examples:**	
Methane molecule contains C and H atoms	The molecule of an organic compound contains C, H and O atoms	The molecule of an organic compound contains C, H and N atoms	Nitric acid molecule contains H, N and O atoms	Carbon dioxide contains C and O atoms
				

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Give reason:

1) **Hydrogen is an elements**
   bec it cannot be dissociated into simpler form by physical and chemical methods
2) **Water is a compound**
   bec. Its components can be separated into oxygen and hydrogen gases by electrolysis
3) **Organic compounds known as carbon compounds**
   bec, they are characterized by the presence of carbon element as the main component

---

The number of atoms in a single molecule of some organic compounds can reach several thousands, as in:

Plastic polymers	Hemoglobin in blood	Vitamin (D)
		Which regulates calcium and phosphorus levels in the blood to prevent **osteoporosis**

	Methane molecule	**Nitric acid molecule**
Type of molecule	Organic compound	Inorganic compound
Molecular formula	CH_4	HNO_3
Number of elements in the molecule	2 elements carbon +oxygen	3 elements hydrogen+oxygen+nitrogen
Number of atoms in the molecule	1C+4H=5 Atoms	1H+1N+3O=5Atoms

Life Application:

-The Egyptian blue dye is a chemical compound. Its molecule is composed of the elements **(Ca+ Cu+ S+ O)**

The Ancient Egyptians used Egyptian blue dye for coloring papyri and statues.

It is still used up till now to color the facades of houses in Nubian villages that form a major tourism destination for both domestic and international tourism.

elements	**Number of atoms**
Ca	**1**
Cu	**1**
S	**14**
O	**10**

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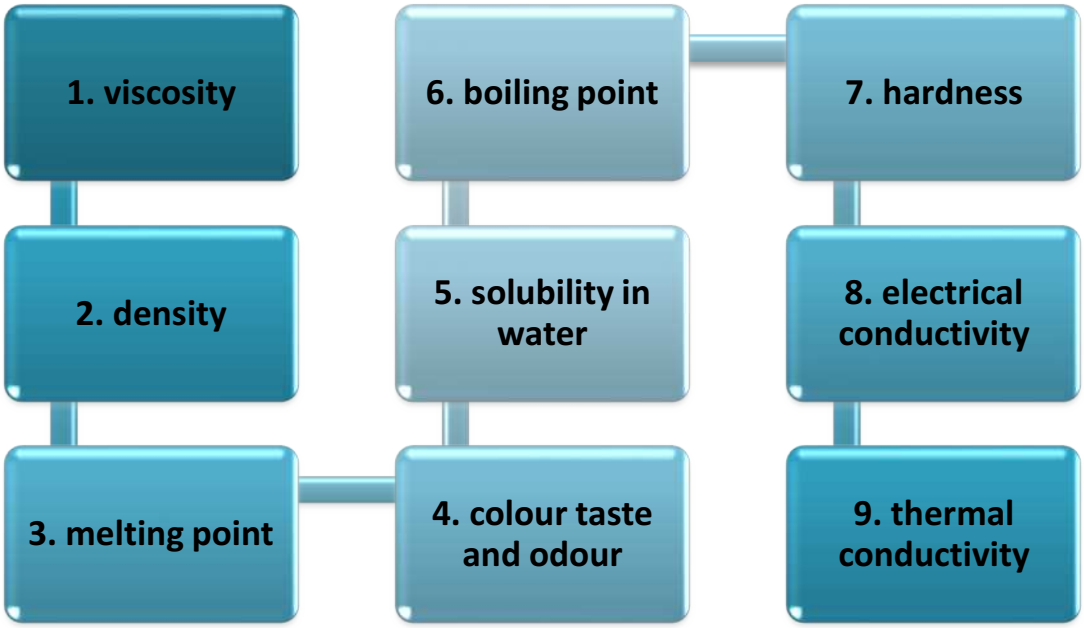
Distinguishing Substances by Their Properties

First

physical properties: they are properties of substance that can be observed and measured in some cases

Some of the physical properties are



1. Viscosity

Viscosity is a physical property of liquids that describes their resistance to flow and the movement of objects through them.

Application: The difference in viscosity between water and honey.

Water has lower viscosity than honey, so it is easier to stir water than honey

---

2. Density

Density is a physical property used to distinguish between materials that float on the surface of water and those that sink in it, where:

- The material that has a density **less than** the density of water **floats** on its surface.

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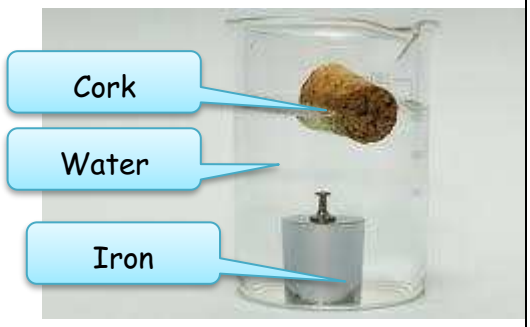
- The material that has a density **greater than** the density of water **sinks** in it



Application: Difference in the densities of cork and iron.

The density of cork is less than that of water, so cork floats on the surface of the water.
The density of iron is greater than that of water, so iron sinks in the water.

---

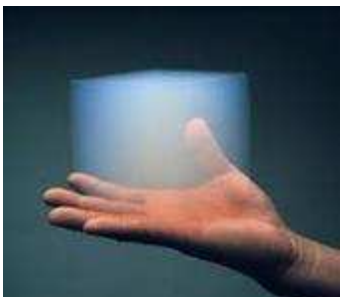
3. Melting Point: The temperature at which the state of a substance starts to change from **solid** to **liquid**

Application: The difference of the melting point of a butter block from the melting point of an aerogel sheet.

The butter block melts easily by heat, while the aerogel sheet is not affected even by a high elevation in temperature.

Technological Application

Aerogel is a transparent, low-density solid material, where 99.8% of its composition is of air only,
it is the lightest known solid material, with high durable. It has excellent insulating properties, so it is used in making the jackets of the researchers in Antarctica as a substitute for polar bear fur to protect its species from extinction.



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Second:

Chemical Properties:

They are properties of the substance that only appear when a chemical reaction occurs, leading to a change in the shape and the composition of the substance.

1. Changes in litmus paper colour according to the substance type:

Different substances have different effects on the two litmus papers, such as:

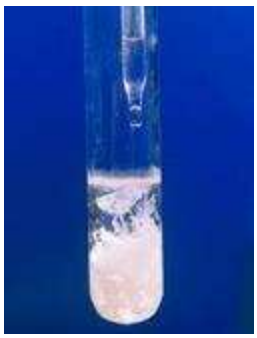
- Substances that turn litmus paper red.
- Substances that turn litmus paper blue.
- Substances that do not affect the color of litmus paper

Application

Lemon juice turns litmus paper **red**, while toothpaste turns it **blue.**

2. A different colored precipitate is formed depending on the type of the used reagent.

- It is possible to differentiate between two different colourless solutions by adding a certain reagent to each of them, where it forms a precipitate with a different colour with each of them.



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Uses of Substances Based on Their Properties

Substance	The appropriate use	Picture
• **Helium:** **<An inert gas>**	An inert gas, less dense than air, and non-flammable. **It is used to fill balloons G.R.?** • **Because** its density is lower than that of air and it is non-flammable.	
•**Nitrogen:** **<A nonmetal gas>**	**It is used to fill car tires instead of air.. G.R.?** • **Because** it is not affected by temperature changes and does not react with rubber.	
• **Stainless steel alloy:** (It is made of iron with added elements)	**It is used to make cooking utensils.. G.R.?** • **Because** it is resistant to rusting	
• **Aluminum-Titanium alloy:**	**It is used in the construction of military aircraft frames (structures).. G.R.?** • **Because** it is lighter than aluminum alone and retains its strength at high temperatures.	

N.B:

Silicon is a metalloid that conducts electricity poorer than metals but better than nonmetals. So we use it in making **computer chips**

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Exercise

Choose the correct answer:

1) Stirring salt and sand together in water forms a……

a. heterogeneous mixture. c) solution.

b. homogeneous mixture. d) compound.

2) All the following can be separated chemically, except…….

a. water. b) methana c) mercury oxide. D) magnesium

3) The element whose molecule consists of two atoms is…….

a. mercury oxide. b) bromine. C) sodium chloride . d) sodium

4) All the molecules of the following gases are monatomic, except……

a. helium molecule. c) argon molecule.

b. oxygen molecule. d) neon molecule.

5) How many elements compose magnesium carbonate molecule $MgCO_3$?

a. 2 b) 3 c) 4 d) 5

6) Balloons can be filled with ……

a. oxygen gas. b) nitrogen gas. C) chlorine gas. d) helium gas.

Correct the underlined words:

1. **Water** molecules can be separated by heating. (……)
2. **Vitamin** A regulates the level of calcium and phosphorus in the blood. (……)
3. A carbon dioxide molecule is **an organic** compound. (……)
4. The molecular formula of nitric acid is **HNO_2** (……)

Give one example for each of the following:

1. Homogeneous mixture. (……)
2. Heterogeneous mixture. (……)

Give reasons of each of the following:

1. **Table salt in water is a homogeneous mixture, while sand in water mixture is a heterogeneous mixture.**

   ……

2. **Methane molecule is an organic compound molecule.**

   ……

3. **Aerogel is used to make jackets for the researchers in cold regions.**

   ……

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Unit 1

Lesson 4 chemical bonds

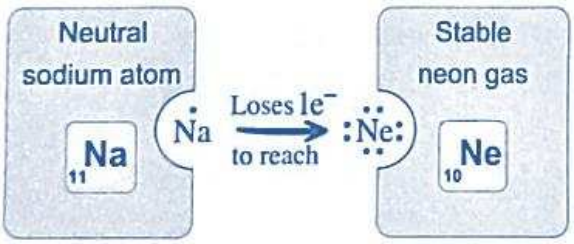
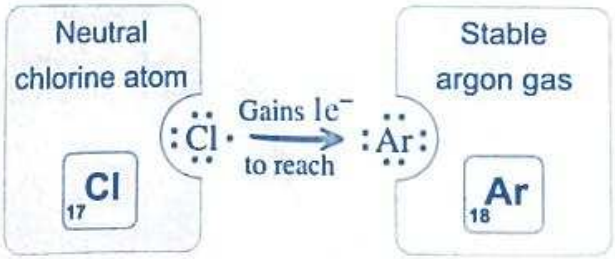
Behavior of periodic table elements

1. Noble gases:

From the Lewis structure of the following noble gases:

The outermost energy level is complete with **8 electrons**, except **helium**, which complete with **2 electrons**; so, they are stable elements.

Their atoms don't bond – under normal conditions – with each other or with other elements.

2. The metals	3. The nonmetals
Metal atoms tend to lose their valence electrons to reach the stable electron configuration of the noble gas with the closest atomic number that precedes them in the periodic table	**Nonmetal atoms tend to gain one or more electrons according to their valencies to reach the stable electron configuration of the noble gas with the closest atomic number that follows them in the periodic table**
	
When a metal atom loses its valence electrons, it converts into a positive ion (cation) carrying a number of positive charges equal to the number of the lost electrons.	**When a nonmetal atom gains electrons, it converts into a negative ion (anion) carrying a number of negative charges equal to the number of the gained electrons.**
The Positive ion (Cation):- **It's a metal atom that has lost one or more electrons.**	**The Negative ion (Anion):-** **It's a nonmetal atom that has gained one or more electrons.**

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Note: When an atom converts into an **ion**, the number of nucleons remains constant without changes, while only the number of electrons changes.

The atom	The ion
• Electrically neutral. • The number of electrons equals the number of protons. • The outermost energy level is **not saturated** with electrons, except the atoms of the noble gases.	• Positively or negatively charged. • The number of electrons does not equal the number of protons. • The outermost energy level is **saturated** (completely filled) with electrons.

1. Positive ion and Negative ion

Positive ion (Cation)	Negative ion (Anion)
• A metal atom that has **lost** one or more electrons.	• A nonmetal atom that has **gained** one or more electrons.
• The number of electrons is **less than** the number of protons.	• The number of electrons is **greater** than the number of protons.
• It carries a number of **positive** charges equal to the number of lost electrons.	• It carries a number of **negative** charges equal to the number of gained electrons.
• The number of its energy levels is **less than** the number of energy levels in its atom.	• The number of its energy levels is **equal to** the number of energy levels in its atom.
• Its electron configuration is **similar** to the electron configuration of the closest **preceding** inert gas in the periodic table.	• Its electron configuration is **similar** to the electron configuration of the closest **following** inert gas in the periodic table.

Chemical Bonding: Atoms are bonded to each other chemically, forming molecules of elements or molecules of compounds.

different ways in which the atoms are bonded to each other lead to different physical and chemical properties of the producing substances.

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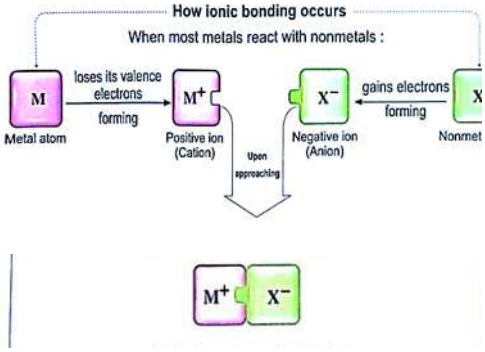
Types of chemical bonding are:

First Ionic Bonding **Second Covalent Bonding**

First: Ionic Bonding: Electrostatic attraction between a positive ion (cation) and a negative ion (anion), forming an ionic compound molecule



The ionic compound is neutrally charged.
Because the number of positive charges equals the number of negative charges in it.

EX:
the ionic bonding in magnesium oxide MgO molecule by the Lewis dot structure.

$_{12}$**Mg: 2,8,2** $_{8}$**0:2,6**

(1) **Ionic bonding results in molecules of compounds only, not molecules of elements.**
Because it occurs between atoms of different elements as a result of the electrostatic attraction between a cation of a metal atom and an anion of a nonmetal atom

(2) Sodium and magnesium elements cannot combine with each other to form a compound molecule.
Because both are metals, their atoms tend to lose their valence electrons and form positive ions, so no electrostatic attraction can occurs between them

---

The Ionic bonding cannot occur between:

1) Two atoms of a metal element (similar atoms), as each of them would form a positive ion.
2) Two atoms of a nonmetal element (similar atoms), as each of them would form a negative ion

Properties of ionic compounds

1) Most of them dissolve in water
2) Both their aqueous solutions (Solutions in water) and their molten can conduct electricity
3) Their melting and boiling points are high

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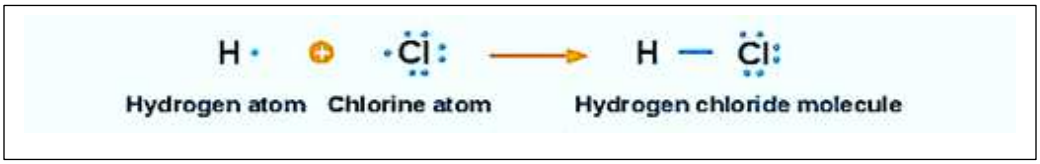
Second: Covalent Bonding:

It occurs between two atoms of the same nonmetal element or between two atoms of different nonmetal elements by **sharing** electrons.

It occurs when each atom shares a number of electrons equal to the number of electrons needed to complete its outermost energy level, **without** losing or gaining electrons.

Covalent bonding in hydrogen chloride molecule HCl

- Chlorine atom shares its single valence electron with the valence electron of the hydrogen atom, forming a single covalent bond.
- The electron pair (the two electrons) that forms this bond revolves around the two atoms in the formed covalent compound molecule (hydrogen chloride HCl).

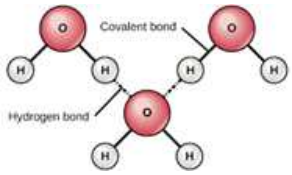


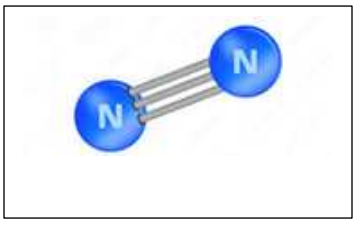
The single covalent bond which is formed by pair of electrons (the electron pair) is represented by **a dash (-)** between the two bonded atoms.

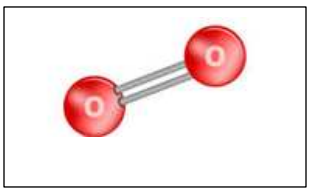
Types of covalent bonds

1) **Single covalent bond**
   EX: hydrogen molecule
2) **Double covalent bond**
   EX: oxygen molecule
3) **Triple covalent bond**
   EX: Nitrogen molecule

water molecule







1) **Covalent bonding may result in the formation of molecules of elements.**
   Because covalent bonding can arise between two atoms of the same nonmetal element
2) **Covalent bonding may result in the formation of molecules of compounds.**
   Because it can arise between two atoms of different nonmetal elements

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Properties of covalent compounds

1) Most of them do **not dissolve** in water
2) They mostly do **not conduct electricity.**
3) Their melting and boiling points are **low**

Ionic bonding	Covalent bonding
Occurs between a positive ion of a metal atom and a negative ion of a nonmetal atom.	Occurs between two atoms of the same nonmetal element or between two atoms of different nonmetal elements.
Involves loss and gain of electrons.	Involves sharing electrons without loss or gain.
Cannot occur between two atoms of the same element.	Can occur between two atoms of the same (nonmetal) element.
Results from the electrostatic attraction between a positive ion (cation) and a negative ion (anion).	Occurs when each atom of the bonded pair shares one or more unpaired valence electrons.
Produces only molecules of compounds (such as NaCl).	Produces element molecules (such as H_2) or compound molecules (such as HCl).

Points of comparison	Sodium chloride	Hydrogen chloride
Type of compound	Ionic compound	Covalent compound
Bonding in the molecule	It is formed due to electrostatic attraction between sodium cation Na^+ and chloride anion Cl^-	It is formed due to sharing an unpaired valence electron from chlorine atom Cl with an unpaired valence electron from hydrogen atom H
Physical state	**Solid**	**Gas**
Melting and boiling points	High	Low
Reactivity with caustic soda (sodium hydroxide) solution	**Does not react**	**Reacts**

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Unique properties of carbon as the main element in organic compounds

The last energy level in carbon atom contains 4 single (unpaired) electrons, Carbon atoms have very unique properties because of their ability to bond with each other in organic compounds in one of three forms

1) straight **2) branched chains** **3) cyclic structures (cycles or rings)**

Figure (7)
Straight chain

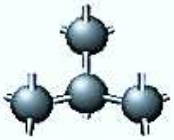
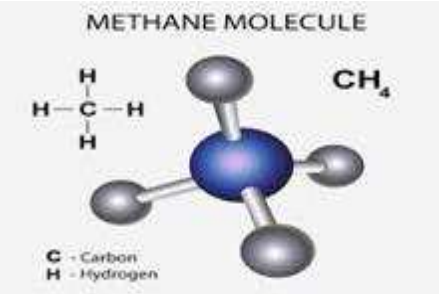


Figure (8)
Branched chain

Figure (9)
Cyclic structure

Methane molecule (The simplest organic compound)

(One carbon atom is bonded to four hydrogen atoms through four single covalent bonds.)



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Exercise

Choose the correct answer:

1. **Noble gas molecule consists of……..**
   a. one atom. c) two different atoms.
   b. two similar atoms. d) three atoms.
2. **The electron configuration of the ion of potassium element $_{19}K$ is similar to the electron configuration of the ion of.....**
   a. O_8 b) $_{11}Na$ c) $_{18}Ar$ d) $_{17}Cl$
3. **The number of electrons in the following ions equals that in sodium ion, except the ion of……**
   a. $_{13}Al$ b) $_{17}Cl$ c) $_{12}Mg$ d) O_8
4. **The bond in hydrogen molecule is……**
   a. ionic. b) single covalent. c) double covalent. d) triple covalent.
5. **The bonds in water molecule are……**
   a. single covalent. c) double covalent.
   b. triple covalent. d) ionic.

Write the scientific term for each of the following statements:

1) **A metal atom that has lost one or more electrons.** (……..)
2) **A nonmetal atom that has gained one or more electrons.** (……..)
3) **The bond which is formed of three pairs of electrons in which each atom shares its three unpaired valence electrons.** (……..)
4) **Compounds, most of them do not dissolve in water and have low melting and boiling points.** (……..)

Give reasons for each of the following:

1. **The stability of the noble gas atoms according to their electron configuration.**
   ……..
2. **Metal atoms tend to lose their valence electrons.**
   ……

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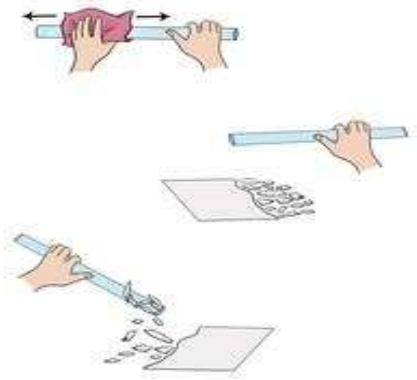
Unit 2

Lesson 1 Electric forces

All materials are composed of electrically neutral atoms **because the number of positive charges equals the number of negative charges** in them. When the balance between positive and negative charges is disturbed, a form of electricity known as static electricity (electrostatic) is produced.



when two objects are rubbed together:

* **Rub the end of an ebonite (hard rubber) rod with a piece of wool, then bring the rod close to light paper scraps (lightweight small pieces) or small foam pieces.**

Rubbing certain objects (like ebonite) with a suitable material (like wool) gives them the ability to attract lightweight objects **because** they have been charged with static electricity (electrostatic) charges.

*** Rub a copper rod instead of the ebonite rod.**

Rubbing (friction) certain objects (like copper) does not give them the ability to attract lightweight objects (paper scraps).

*** The electric charges settle on the surface of the rubbed part of the object only and do not transfer to the rest of it.**

Objects that can be charged with an electrostatic charge can be made of:

1) Objects made of **non-conducting materials (insulators)** , such as: **wood, paper, wool, silk, and glass.**
2) Objects made of materials that **conduct electricity**, but the charged part must be insulated to prevent the leakage of electric charges, such as **metals** (Copper, iron and Aluminum) and **carbon.**

***Feeling a slight electric shock when touching a metal door handle after walking barefoot on the carpet...**

*** Hearing a slight crackling sound when taking off woolen clothes in winter...**

Because the charge formed on the body is discharged as a result of the friction

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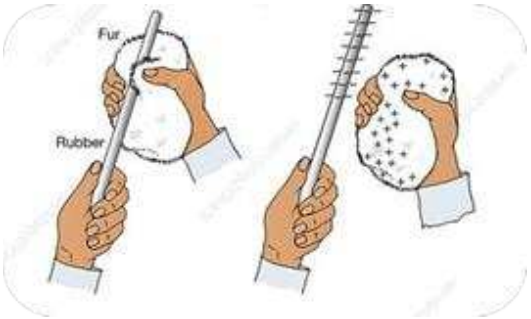
Charging by friction (Rubbing): the process of charging two uncharged objects by rubbing two objects together

Static Electricity electrostatic): The accumulated charges on the surfaces of objects when they lose or gain electrons

When two different uncharged objects are rubbed together:

Electron transfer from the atoms found on the surface of one object to the atoms found of the surface of the other object, causing both to become electricity charged with equal magnitude of charge but opposite in type (sign)

1) The object that **loses** electrons ⟹ becomes **positively** charged.
2) The object that **gains** electrons ⟹ becomes **negatively** charged.



When an ebonite rod is rubbed with a piece of silk, electrons transfer from the silk to the ebonite rod.

Weak electric charges are measured by a device known as measured in units of **Coulombs**

Charles-Augustin de Coulomb

- A French physicist who formulated a law describing electric forces between charged particles, known as Coulomb's Law or the Inverse Square Law.

- His studies and discoveries in the late 18th century laid the foundation for the development of electromagnetic theory.

- In his honor, **the unit** of electric charge (Coulomb) is named after him

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Type of charge acquired by the rubbed object differs depending on the material of the rubbing object.

Electrostatic Series : The arrangement of materials according to the easiness of losing electrons when rubbed together.

Glass
Wood
Synthetic leather
Silk
Wool
Cotton
Paper
Ebonite

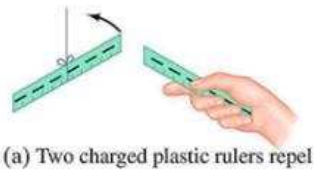
Table (1)
Electrostatic series

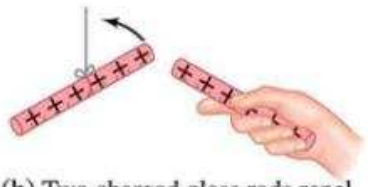
When one material rubbed with another:

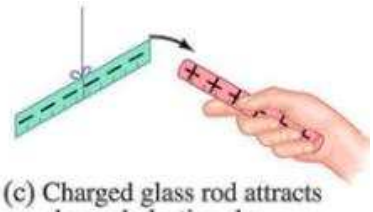
1) The material **higher** on the series
   Will be charged with a **positive electric charge**
2) The material **lower** on the series
   Will be charged with a **negative electric charge**

The Electric Forces

1) When the two objects **have the same type** of the electric charges a **repulsive electric force** arises between them.
2) When the two objects **have different type** of the electric charges an **attractive electric** force arises between them


(a) Two charged plastic rulers repel

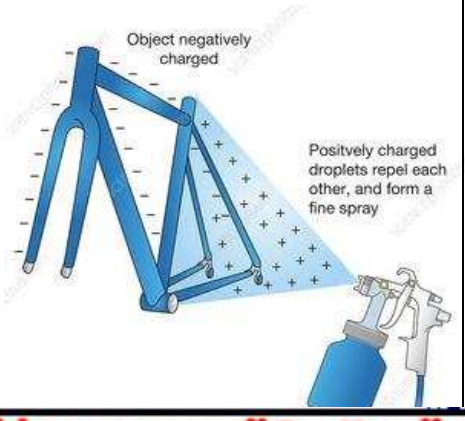

(b) Two charged glass rods repel


(c) Charged glass rod attracts charged plastic ruler

Life Applications: of the Attraction of Opposite electric charges.

- The Electrostatic Planting
  - ❖ Importance: **metal planting**

When the object to be plated is charged with negative electric charge the paint spray with positive electric charge is sprayed, attraction occurs between the object and the paint spray due to the difference in charges



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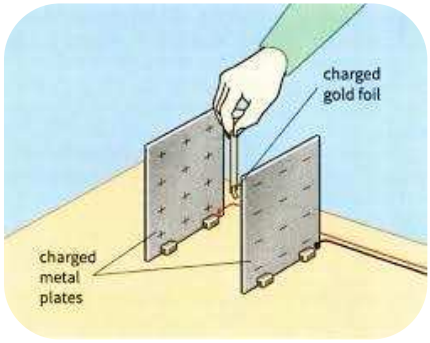
Advantages:

1. Ensures an even layer of paint
2. Reduces paint waste.

Scientific Prediction:

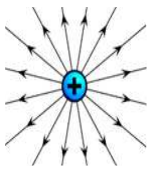
When passing a beam of subatomic particles through an electric field composed of two plates, one is positively charged and the other is negatively charged then:

1. **Neutrons** pass in a **straight line without deviation**, because they are **neutrally charged**.
2. **Protons** are deviated toward **negative plate**, because they are **positively charged.**
3. **Electrons** are deviated toward **positive plate**, because they are **negatively charged.**

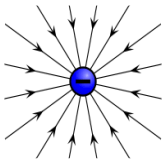


Electric field: of a charge can be represented by lines known as electric force lines or electric field lines

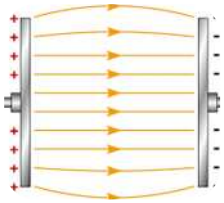
The Electric field: the region surrounding an electric charge in which its effect appears
Electric field lines: Imaginary lines that show the path taken by a small free moving positive charge in the electric field.



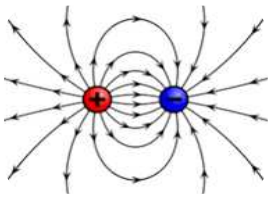
Electric force lines for a positive charge



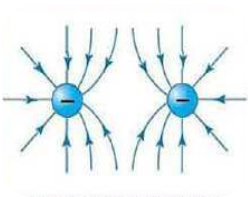
Electric force lines for a negative charge



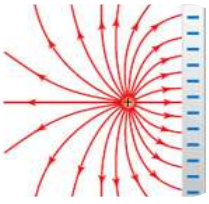
Electric force lines between two metal plates charged with opposite charges



Electric force lines for two opposite charges



Electric force lines for two similar charges



Electric force lines between a charged plate and an opposite charge

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The properties of the electric force lines:

1) Electric force lines are imaginary lines that do not intersect each other.
2) They start from the positive charge and end at the negative charge.
3) They ends at the surfaces of charged metal objects and do not penetrate them

The Electroscope device

It's composition:

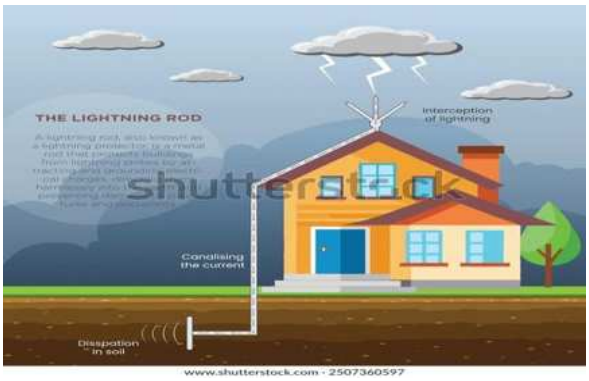
3) Copper disc - copper rod
4) Glass container - Two gold leaves

Its uses:

1. Detecting if an object is electrically charged.
2. Determining the type of the charge on a charged object.
3. Comparing the magnitude of charges on different charged objects.

Discharging the Electrostatic charges:

1) Feeling slight electric shock when touch metal doorknob after walking barefoot on a carpet
2) Hearing a slight crackling sound when taking off woolen clothes
3) Metal chains are suspended from the fuel truck and touch the ground
4) **Lightning rod :** it is a metallic rod to protect buildings from lightning strikes
   its lower end buried under the ground
   its upper end pointed near the clouds



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Exercise

Choose the correct answer:

1. **Among the electrical conductors is……**
   a. metal nail. b. plastic straw. c. wooden ruler. d. a glass rod.
2. **All the following are electrical nonconducting materials, except…….**
   a. carbon. b. wood. c. silk. d. bonite.
3. **Which of the following materials gains electrons when rubbed with a piece of wool?**
   a. Wood. b. Glass. c. Paper. d. Silk.
4. **All the following materials precede cotton in the electrostatic series, except……**
   a. glass. b. ebonite. c. wool. d. silk.
5. **All the following describe the electric field lines, except that they…….**
   a. are imaginary lines. c. do not penetrate metallic surfaces.
   b. are intersecting lines. d. start at the positive charge.

Mention one importance for each of the following:

1. **Electrostatic plating.** ……
2. **Coulomb meter** ……
3. **Electroscope.** ……

Write the scientific term of each of the following statements:

1) **The charges formed on the object that loses electrons when rubbed.** (……)
2) **The measuring unit of electric charge** (……)
3) **Imaginary lines that show the path taken by a small free-moving positive charge placed in the electric field.** (……)
4) **The process of charging an uncharged object by another charged object due to their contact** (……)

Give reason of each of the following:

1) **Hearing crackling sound when taking off woolen clothes in winter.**
   ……
2) **The attraction of paper pieces to an ebonite rod rubbed with wool**
   ……

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Unit 2

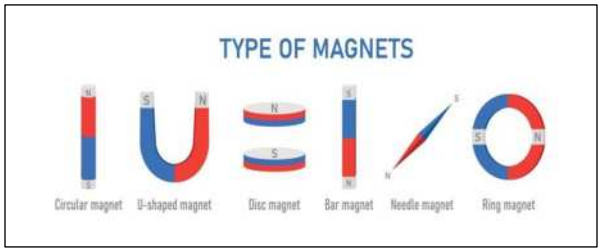
Lesson 2 **Magnetic forces**

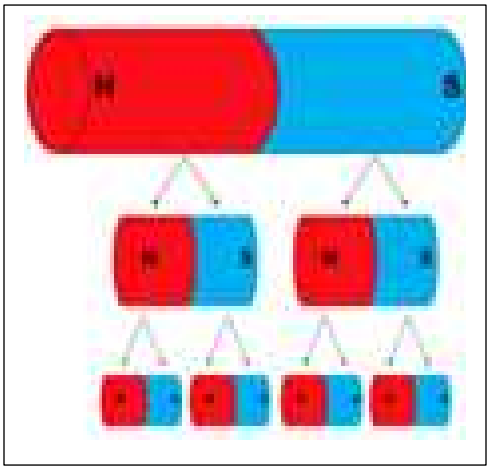
The Magnets: Is a natural magnet rock **(lodestone)** that was found in Magnesia (a regional unit) of ancient Greece

it has the ability to attract certain metallic objects

The production of the industrial magnets began in the 19th century. There are different shapes of artificial magnets

(Bar magnet, Horse shoe magnet, Magnetic Needle, Ring magnet)





*When a single magnet is divided into several parts,
each part forms a new magnet with two poles,
one is the **north (N)** and the other is the **south (S)**
* It is impossible to obtain an isolated (only one) magnetic pole.

Metallic materials are classified according to their attraction to magnets into:

Magnetic materials				**Non-magnetic materials**			
- Materials that are attracted to a magnet.				- Materials that are not attracted to a magnet.			
Steel	Cobalt	Iron	Nickel	Gold	Aluminum	Copper	Silver

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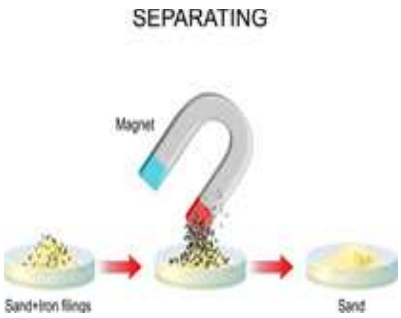
What happens when?

A magnet is brought close to the mixture of copper fillings, iron fillings and sand?

Only iron fillings are attracted to the magnet.

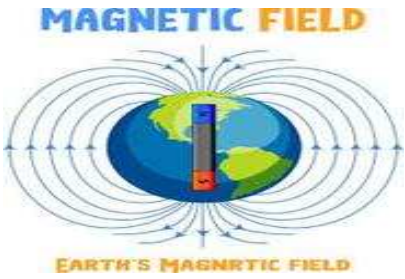


Life Application:

Forensic and criminal investigation experts use a **magnetic brush** and **iron filings** in criminal investigations **to reveal the unclear fingerprints** where the brush is passed over surfaces with the unclear fingerprints, causing some iron filings to stick to the traces left by the fingerprints, which makes them visible.

Properties of Magnets

1) The attraction force of the magnet is the strongest at its poles, and it decreases as it gets closer to the middle of the magnet.



2) **When a magnet is suspended freely**, its **north pole (N)** almost points towards the Earth's geographical North Pole, while its **south pole (S)** points towards the Earth's geographical South Pole

Life Application

The compass is an old tool used to determine the Earth's four main geographical directions.

- It consists of a free-moving magnetic needle fixed at its pivot (axis)
- It is placed inside a box made of copper or plastic..**G.R? To** prevent the attraction between the needle and the box material, which can effect on its movement.

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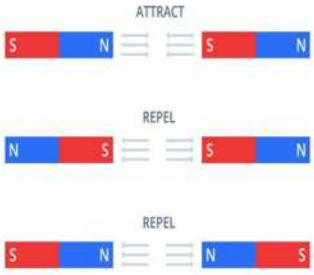
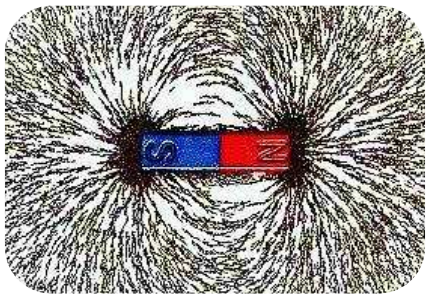


Law of attraction and repulsion:

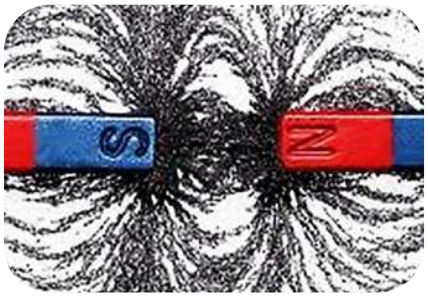
Like magnetic poles repel each other, and **unlike magnetic** poles attract each other.

Magnetic Field: the region of space around magnet where the effect of its magnetic force appears

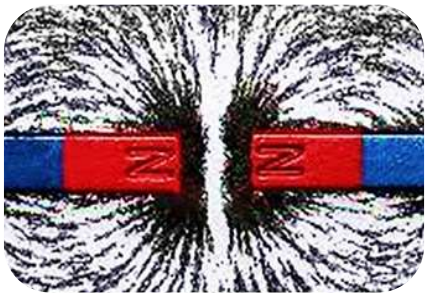
Magnetic field lines: they are imaginary lines that represent the force of the magnetic field



Magnetic field lines of a magnet



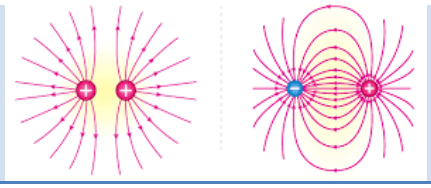
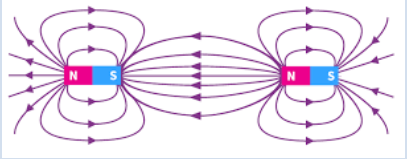
Magnetic field lines between two opposite poles of two magnets



Magnetic field lines between two similar poles of two magnets

Properties of Magnetic field lines:

1) Imaginary lines that don't intersect each other
2) They start from **north pole** and end at **south pole**
3) they are **denser** near the poles and **far separated** as they move away from them

Electric field	Magnetic field
The region of space around an electric charge where its effect appears in it.	The region of space around a magnet where the effect of its magnetic force appears in it.
Represented by imaginary lines called electric field lines.	Represented by imaginary lines called magnetic field lines.
	

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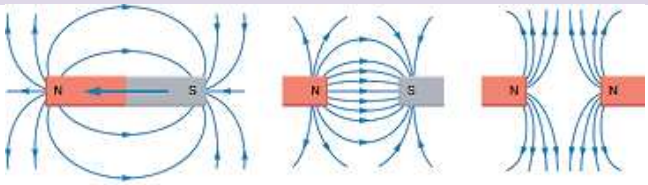
Electric field lines	Magnetic field lines
Imaginary lines that do not intersect each other.	Imaginary lines that do not intersect each other.
They start from the positive charge and end at the negative charge.	They start from the north pole of the magnet and end at the south pole of the magnet.
They end at the surfaces of charged objects and do not penetrate them.	They are denser near the poles and far separated as they move away from them.
	

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Exercise

Choose the correct answer:

1. **All the following metals are attracted to a magnet, except……..**
   a. aluminum. b. cobalt. c. nickel. d. iron.
2. **All the following are industrial magnets, except……**
   a. horse shoe magnet. C. lodestone.
   b. magnetic needle. d. bar magnet.
3. **The south pole of a compass needle points to……..**
   a. The geographical east pole of the earth.
   b. The geographical north pole of the earth.
   c. The geographical west pole of the earth.
   d. The geographical south pole of the earth.

Give reasons of each of the following:

1- **Forensic experts use a magnetic brush and iron filings to reveal the unclear fingerprints**
……..
2- **Both iron and steel are magnetic materials.**
……..
3- **The magnetic needle of a compass is placed inside a copper box**
……

Write the scientific term of each of the following statements:

1- **The geographical pole of the Earth that the north pole of a freely-suspended magnet points to.** (……..)
2- **Like magnetic poles repel, and unlike magnetic poles attract** (……)
3- **Imaginary lines that represent the force of the magnetic field.** (……)

What happens when:

1) **A magnet is divided into several parts**
……..

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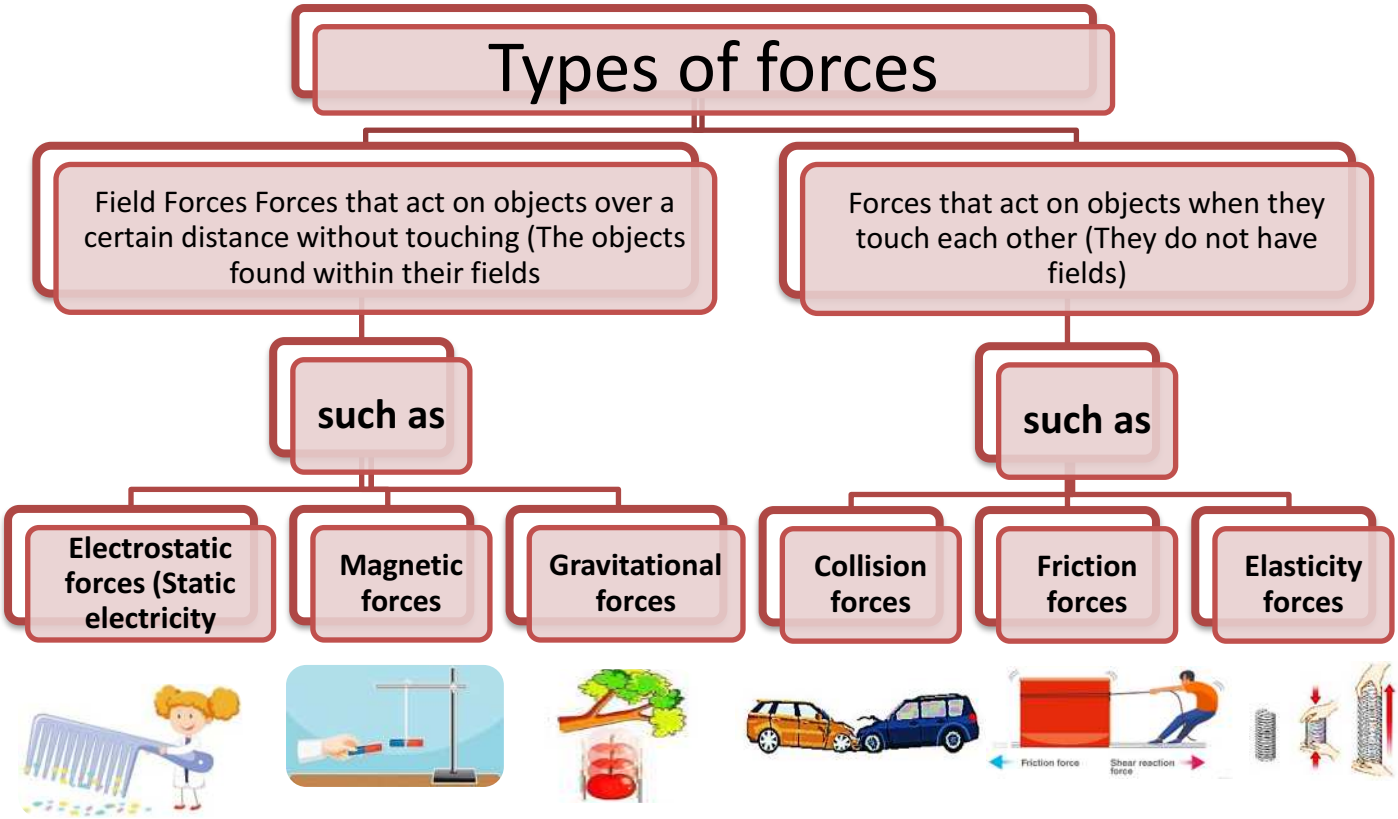
Unit 2

Lesson 3 **Gravitational forces**

Classification of the Forces

Forces in nature can be classified into two types,


Types of forces
Field Forces Forces that act on objects over a certain distance without touching (The objects found within their fields
Forces that act on objects when they touch each other (They do not have fields)
such as
such as
Electrostatic forces (Static electricity
Magnetic forces
Gravitational forces
Collision forces
Friction forces
Elasticity forces
Friction force
Shear reaction force

G.R Gravitational, electric and magnetic forces have fields, while frictional forces do not.

Because gravitational, electric and magnetic forces act on objects at a distance without contact, while frictional forces are considered contact forces

Earth's Gravitational Field

- The scientist Newton discovered that all material objects in the universe attract each other, and in recognition of his scientific contributions, the unit of force (Newton) was named after him

Isaac Newton

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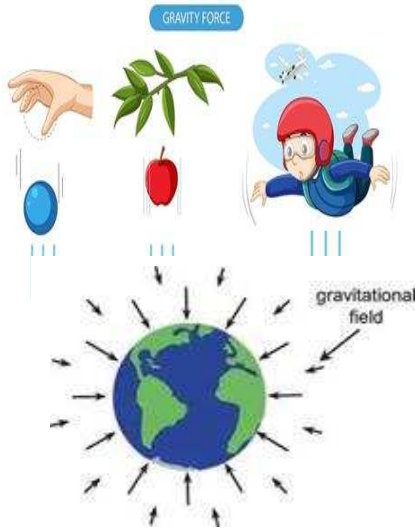


- Earth's gravitational force causes all objects to fall downwards in the direction of Earth's center

Earth's Gravitational Force: The force that pulls (attracts) all objects downward towards the center of the Earth

- The effect of Earth's gravitational force on material objects within the space surrounding the Earth is referred to as the **Earth's gravitational field.**

Earth's Gravitational Field: The space in which the Earth's gravitational force affects material objects, with an attraction force towards the center of the **Earth.**

- Earth's gravitational force is represented by lines called **Earth's gravitational field lines**, and the direction of the arrow indicates the direction of the gravitational force acting on an object placed in its field.

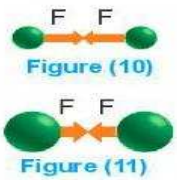
Earth's Gravitational Field Lines: Lines that represent Earth's gravitational force.

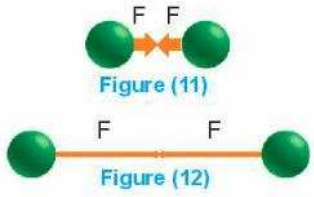
The Mutual Attraction Forces between Two Objects

Gravitational force is not only between the Earth and objects within its gravitational field but also between any two objects

This mutual attraction force (F) depends on:

1. **The masses of the two objects**
2. **The distance between the centers of the two objects**





G.R

The attraction force represented in (11) is greater than that in (10)

The attraction force represented in (11) is greater than that in (12)

Because

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The Role of Gravity in the phenomenon of tides:

The masses of the two objects in (11) are greater than those in Figure (10)	The distance between the centers of the two objects in (11) is less than that in (12)

it is clear that:

1. Gravitational forces are mutual forces between two objects, it acts on each of the two objects by equal magnitude but in opposite directions
2. Gravitational forces:
   - **increases** as the **masses** of the two objects increase
   - **Decreases** as the **distance** between the centers of the two objects increases.

Effect of gravitational force

1. The stability of the objects, rainfall, and all the objects falling towards Earth.
2. The occurrence of the phenomenon of tides (tidal phenomenon).
3. This phenomenon is of black holes
4. Orbital motion.

The presence of a gravitational attraction force between the Moon and Earth results in a natural phenomenon known as tides

Tidal Phenomenon: It is a natural phenomenon that occurs due to the gravitational attraction force between the Moon and Earth, causing periodic changes in elevation and recession of water in the seas and oceans.

- The tidal phenomenon is most noticeable in the Bay of Fundy in Canada, where the difference between the elevation and the recession of water reaches 19 meters

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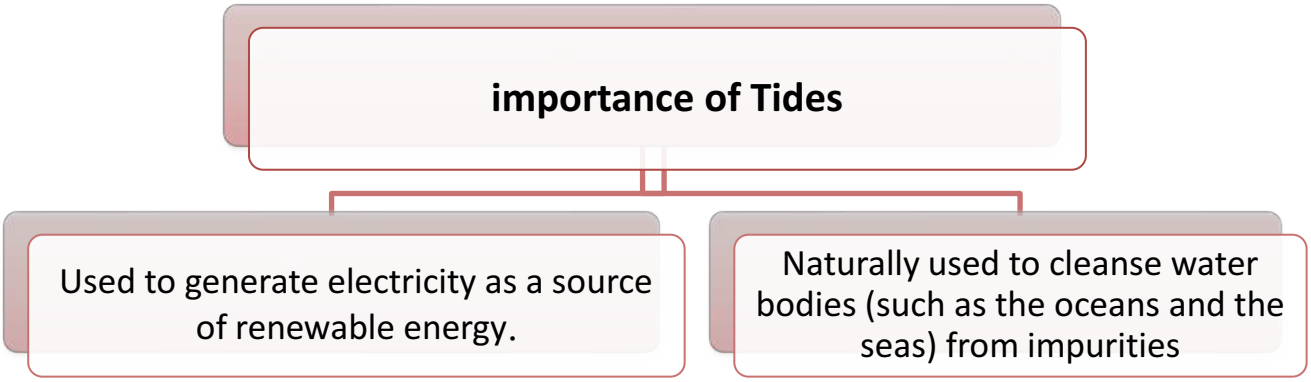
Characteristics of Tides: 1) Tides occur periodically and regularly twice daily (once every 12 hours)

2) Tides are at their peak (highest elevation of water waves) when the Moon is either new moon or full moon


importance of Tides
Used to generate electricity as a source of renewable energy.
Naturally used to cleanse water bodies (such as the oceans and the seas) from impurities

The Role of Gravity in black holes

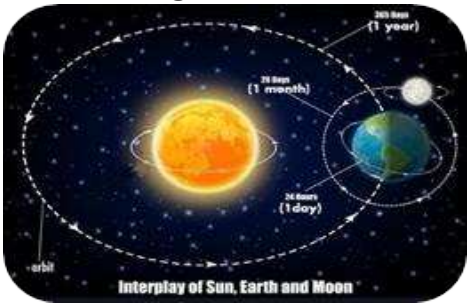
Scientists in the early 20th century discovered regions in the space known as black holes, which are formed when a massive star collapses at the end of its life. Black holes are characterized by immense gravity, so that even light cannot escape from them.

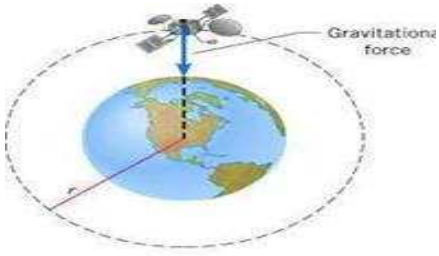
BLACK HOLES: regions in space formed duo to the collapse of a massive star at the end of its life.

The Role of Gravity in Orbital Motion

There is a gravitational attraction between any object moving in a curved path in space around another central object (orbiting this central object). This motion is known as **orbital motion:**

the rotation of any object in space around another central body in a curved path duo to the gravitational attraction force between them.





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Examples of orbital motion

- The motion of the moon around the Earth.
- The motion of the Earth around the Sun.

- The motion of the satellites around the Earth (Depends on earth's gravitational force).

The Relation between Weight and Gravity

The Mass

The amount of matter an object contains.

The Weight

The gravitational force that earth exerts on the object

the relation between the weight (in Newton's) and the mass (in kilograms) can be represented in a graph, where weight is represented on the vertical axis, and mass on the horizontal axis, as shown in the opposite graph:

Figure (19)

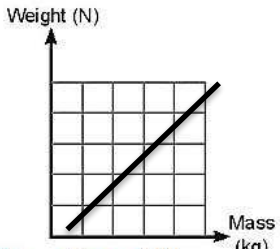


Figure (20)

1) The weight of an object increases as its mass increases.
2) The weight of an object can be calculated by using the following mathematical relation

Weight (w) = Mass (m) × Gravitational field intensity (g)

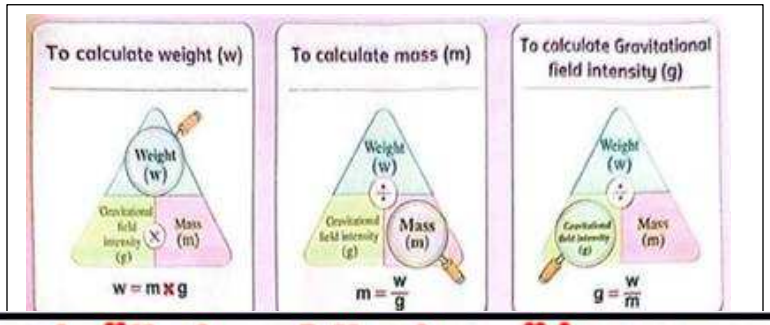
* Knowing that Earth's gravitational field intensity is approximately **(10 N/kg)**

What is meant by?

The weight of an object(Earth's surface is 20 N

- This means that the gravitational force tha earth exerts on the object equals 20

The relation between the weight of an object and the gravitational field intensity acting on it



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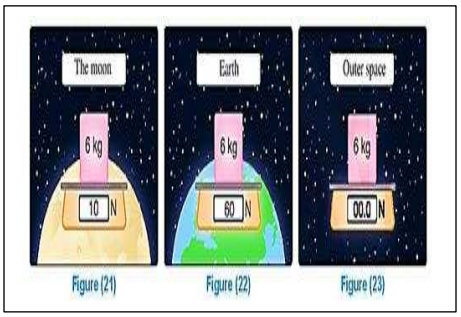

1) The mass of an object remains constant and does not change from one place to another, while the weight of an object changes from one place to another.

Because the mass of an object is the amount of matter it contains, which is a constant quantity that does not change, while the weight of an object changes due to the difference in the gravitational field intensity acting on it

2) The Earth's gravitational pull on objects is greater than the moon's gravitational pull on them.

Because the gravitational field intensity of the moon is equal to $\frac{1}{6}$ the gravitational field intensity of Earth

3) The Earth's gravitational field intensity: changes according to the distance from Earth's center

	Decreases as you move away (upwards) from the Earth's center (by ascending above the Earth's surface).
	Increases as you move closer (downwards) to the Earth's center (by descending towards the Earth's surface

(1) The weight of an object in outer space becomes zero.

Because there is no gravity in outer space (the magnitude of the force of gravity is zero).

(2) The weight of an object changes from one planet to another.

Because the gravitational field intensity changes from one planet to another

	Mass (m)	Weight (w
Definition	The amount of matter the object contains	The gravitational force that earth exerts on the object
Measuring unit	Measured in kilograms (kg)	Measured in Newtons (N)
Mathematical law	$m = \frac{W}{g}$	$w = m \times g$
Change in magnitude with changing object's position	Its magnitude does not change with changing object's position (remains constant)	Its magnitude changes with changing body's position from one place to another

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Exercise

Choose the correct answer

1- The force that attracts all objects downward towards the Earth's center is a (an)……force.

a.Magnetic b. field c. electrostatic d. contact

2- All the following describe the importance of gravitational force, except that it is responsible for…….

a. stability of the objects on Earth's surface.
b. causing rainfall on the Earth's surface.
c. causing the phenomenon of tides.
d. reducing the friction between two objects.

3- **The phenomenon of tides occurs……daily**.

a. three times b. four times c. twice d. once

4- Which of the following forces are field forces?

a. Magnetic and electrostatic forces.
b.Gravitational and friction forces.
c. Elasticity and collision forces.
d. Magnetic and elasticity forces

Give reasons for each the following:

1- The rainfall and the falling of the objects towards the Earth

……

2- **The formation of black holes in the space**

……

Write the scientific term which indicates each of the following statements

1- Lines that represent the Earth's gravitational force (……)

2- Regions in the space formed due to the collapse of a massive star at the end of its life. (……)

3- Forces that act on objects when they are in contact with each other

(……)

4- The space in which the Earth's gravitational force affects material objects with an attraction force towards the Earth's center. (……)

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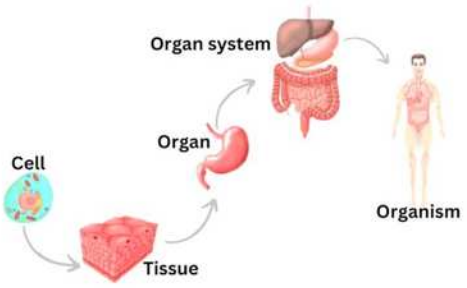
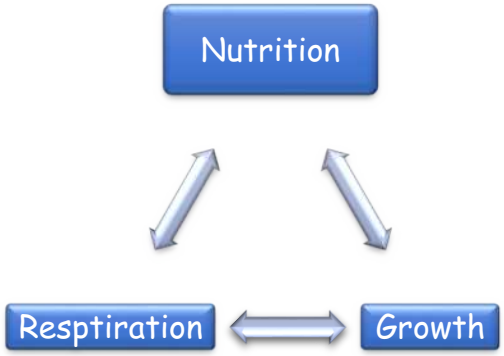
Unit 3

Lesson 1 — Cells and life

The cell is the smallest (tiny) structural unit in any living organism; it performs various vital processes necessary for the continuation of life such as:

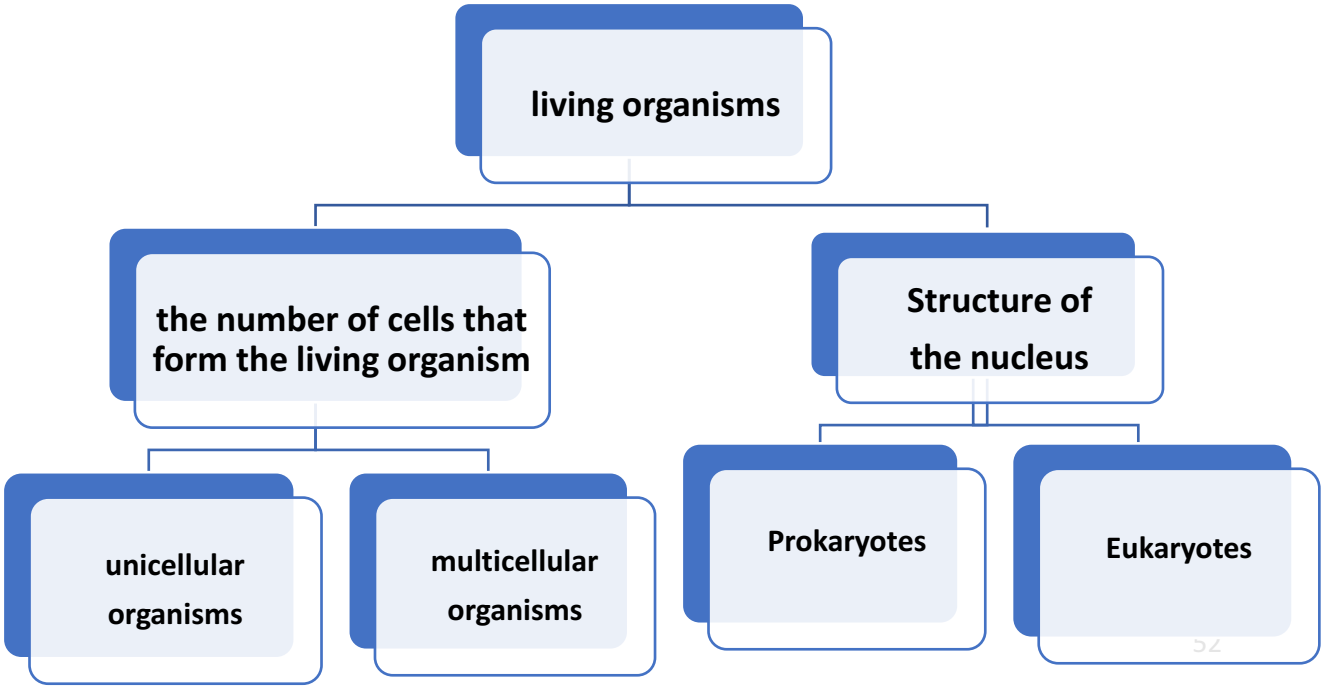




Classification of Living Organisms:

Classification: the arrangement of living organisms into groups based on their similarities and differences to facilitate their study and identification

There are multiple bases for classifying living organisms, and the following diagram shows one such classification attempt:



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First: Unicellular & multicellular organisms:

1) Unicellular Organisms:

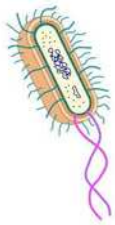
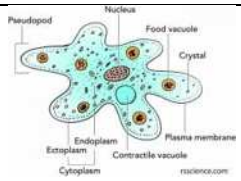
Microorganisms characterized by the following characteristics, including:

- Their body consists of a single cell, so they are called: **unicellular organisms.**
- **Unspecialized**, meaning that the cell performs all vital processes necessary for life.
- They cannot be seen by the naked eye, but can be observed under a light microscope, so they are called **microscopic organisms.**

Examples:

•Yeast fungus. •Bacteria.

•Protozoa **such as:** *Amoeba* and *Paramecium.* •*Euglena*

Organism	Bacteria	*Amoeba*	*Paramecium*	*Euglena*
The shape of living organism under light microscope				
The schematic diagram of the living organism				

Bacteria, *Amoeba* and *Paramecium* are classified as microscopic organisms.

Because they are unicellular organisms that cannot be seen by the naked eye, but can be observed under a light microscope.

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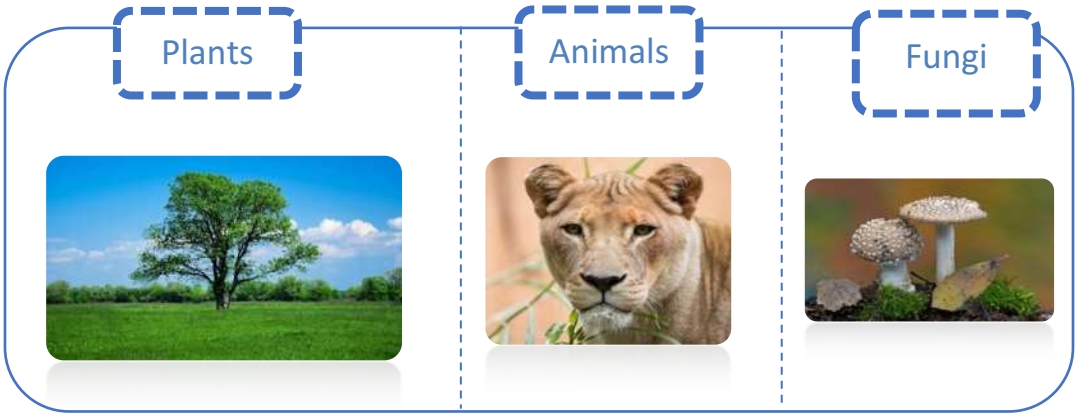
2) **Multicellular Organisms:**

Living organisms characterized by the following characteristics, including:

- Their body consists of many cells, so they are called multicellular organisms.
- Their cells are differentiated, meaning that they vary in their shape and structure.
- Their cells are **specialized** in their function, meaning that each group of cells performs specific vital processes.
- Relatively large in size and can be seen by the naked eye.

Examples:

- **Plants.**
- **Animals**.
- **Fungi**, such as: Bread mold fungus and Mushroom fungus.



Human cells are differentiated and specialized.

They are differentiated because they vary in their shape and structure, and specialized because each group of cells performs specific vital processes.

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Second: **Prokaryotes and Eukaryotes**:

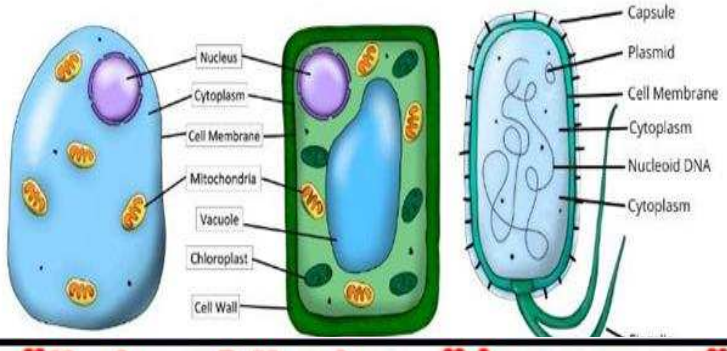
	Prokaryotes:	**Eukaryotes**:
Living organisms characterized by the following characteristics:	• All are **unicellular.** • Simple in structure. • Relatively small in size. • Their genetic material in the cell is found in the cytoplasm and not surrounded by a nuclear membrane. • Many cell organelles are missing (absent)	• They may be **unicellular** or **multicellular.** • Their body is more complex. • Relatively large in size. • Their genetic material in the cell is surrounded by a nuclear membrane, separating it from the cytoplasm (True nucleus). • They contain many cell organelles.
Examples	• Bacteria	• Yeast fungus and *Euglena.* • Protozoa such as *Amoeba* and *Paramecium* **(unicellular organisms).** • Plants like beans and animals like lions **(multicellular organisms).** • Fungi such as bread mold fungus and mushroom fungus **(multicellular organisms).**

(1) Bacteria are classified as prokaryotes.

Because their genetic material in the cell is found in the cytoplasm and not surrounded by a nuclear membrane

(2) *Euglena* is classified as a eukaryote.

Because its genetic material in the cell is surrounded by a nuclear membrane, separating it from the cytoplasm



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	Prokaryote	Eukaryotes	
	Bacterial cell	Animal cell	Plant cell
Presence of cell wall	✓	✗	✓
Presence of plasma membrane (cell membrane)	✓	✓	✓
Nucleus	✗	✓	✓
Cytoplasm	✓	✓	✓
Golgi apparatus	✗	✓	✓
Ribosomes	✓	✓	✓
Endoplasmic reticulum	✗	✓	✓
Mitochondria	✗	✓	✓
Centrosome	✗	✓	✗
Chloroplasts	✗	✗	✓
Vacuoles	✗	✓	✓

1) **The bacterial, animal and plant cells all share the presence of:**

Plasma membrane (cell membrane). Cytoplasm Ribosomes

2) **The plant cell shares with the animal cell the presence of**

Plasma membrane (cell membrane). •Nucleus. •Cytoplasm

Cell organelles, such as: •Golgi apparatus. •Mitochondria. •Vacuoles

3) **The plant cell differs from the animal cell in the presence of**

Cell wall. Chloroplasts Large vacuole

4) **The animal cell differs from the plant cell in the presence of:**

Centrosome. Small vacuoles

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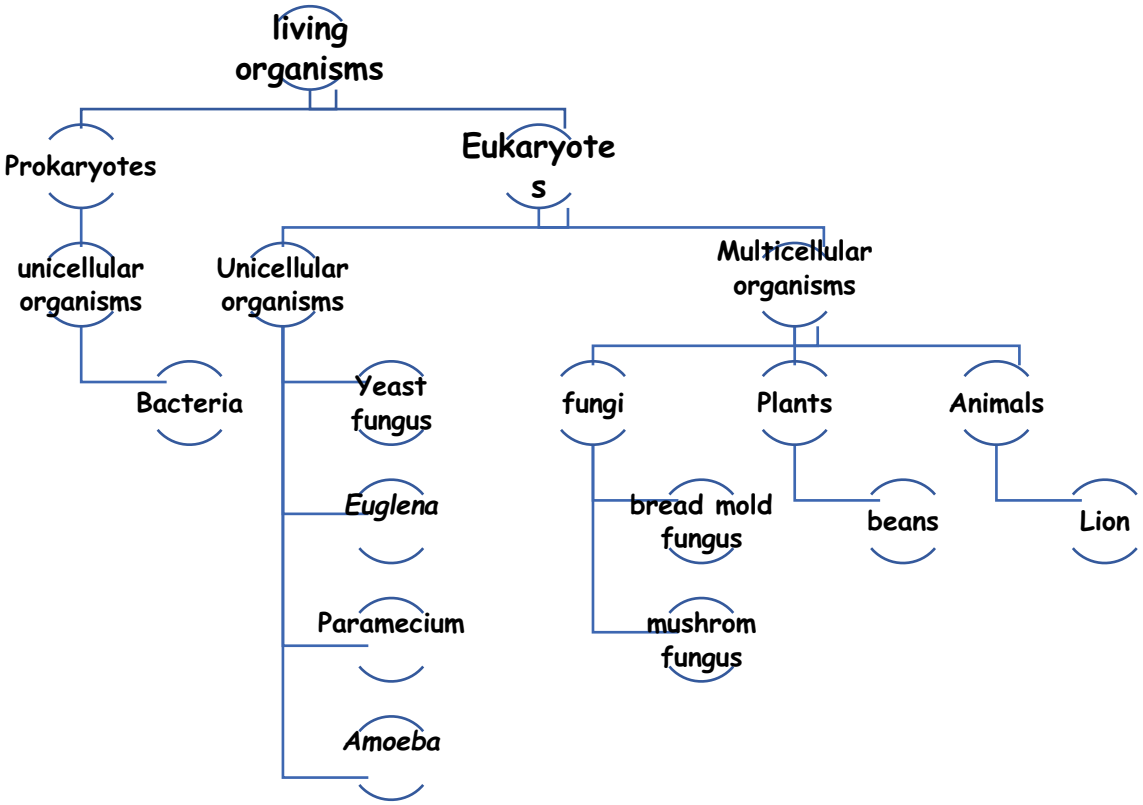

	Unicellular organisms	Multicellular organisms
Body structure	Their body consist of a single cell	Their body consist of many cells
Cell specialization	Unspecialized	Specialized
Size	Microscopic, cannot be seen by the naked eye, but can be observed under a light microscope	Relatively large in size, and can be seen by the naked eye
Nuclear structure	Prokaryotic	Eukaryotic
Examples	•Yeast fungus. •Bacteria. •Protozoa such as *Amoeba* and *Paramecium.* •*Euglena.*	•Plants. •Animals. •Bread mold fungus. •Mushroom fungus.

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Stem Cells:

When you visit the pottery village in [Fustat city], you will find various pottery artefacts created by the Egyptian artists from clay.

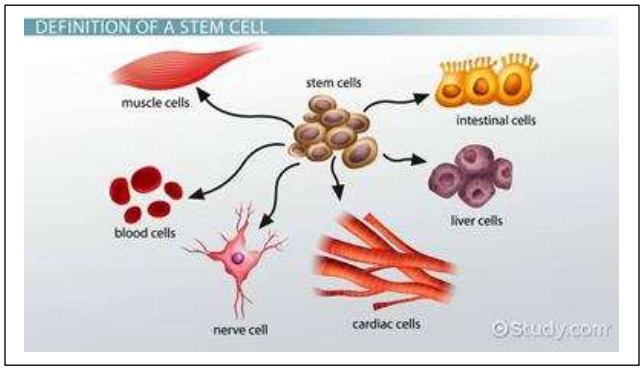
Clay can be transformed into various shapes of pottery, there is a type of cell that can be transformed into many types of cells in higher animals and human, known as **stem cells.**

"Undifferentiated cells that have the ability to be transformed and differentiated into all the differentiated cells of the body that performs a specialized function"

Stem Cells in human:

It's characteristics:

1) Their ability to renew themselves through division and produce more stem cells.
2) Their ability to differentiate into specialized types of cells found in the body.



The function of the cell differs depending on its structure. For example, the composition of muscular tissue from long muscle cells (fiber) allows it to perform the functions of contraction and relaxation.

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Medical applications:

Researchers hope that stem cell studies will help to:

- Increase understanding of how diseases occur, by observing cell differentiation, it is possible to understand when they turn into healthy or diseased cells.
- Producing healthy cells to replace cells infected by disease.
- Test new drugs before use to determine their safety and effectiveness where stem cells are grown in the laboratory and treated with tested drug.

Scientific experiments have proven the effectiveness of stem cell therapy in certain diseases, such as:

- Bone marrow failure.
- Heart and vascular diseases.
- Diabetes.
- Burns.

Can prokaryotes form stem cells? Explain.

No / Because prokaryotes are composed of a single, unspecialized cell that performs all vital processes, while stem cells are undifferentiated cells that have the ability to be transformed into differentiated and specialized cells in eukaryotes such as higher animals and human.

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Exercise

Choose the correct answer:

1) The body of a lion consists of a group of……..

a) systems. b) organs. c) tissues. d) cells.

2) The building units that form a tissue are called……

a)organelles. b) systems. c) cells. d) organs.

3) A cell that performs all vital processes is described as……

a) differentiated. c) undifferentiated.

b)specialized. d) unspecialized

4) Both plant and animal cells are characterized by the presence of……

a) Plasma membrane and centrosome.

b) plasma membrane and cytoplasm.

c) cell wall and nucleus. d) cell wall and cytoplasm

Give reasons for:

1. **The cell is the basic unit of function in living organisms.**

   ……

2. **The importance of classifying living organisms into groups based on scientific principles.**

   ……

Write the scientific term of each of the following statements:

1. **The building units that precede organs.** (……)
2. **Microorganisms whose genetic material is not surrounded by a nuclear membrane**. (……)
3. **The building units that are directly above tissues**

   (……)

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Unit 3

Lesson 2 General characteristics of living orgaisms

General characteristics of living organisms:

the vital processes that living organisms perform to sustain life and distinguish them from non-living

- Nutrietion
- Respiration
- Transport
- Excertion
- Movement
- Growth
- Sensation
- Reproduction
- Adaptation

The general characteristics of living organisms in prokaryotes and eukaryotes:

1) **Nutrition: One of the characteristics of living organisms, in which they obtain food, that represents the main source of energy, and produces substances that are used in building their body.**

Living organisms obtain their food in different ways; they may be:

Autotrophic organisms (Autotrophs)	Heterotrophic organisms(Heterotrophs)
Organisms that can make their own food through photosynthesis and they are called **producers.**	Organisms that depending directly or indirectly on other producers to obtain their food, and they are called **consumers**

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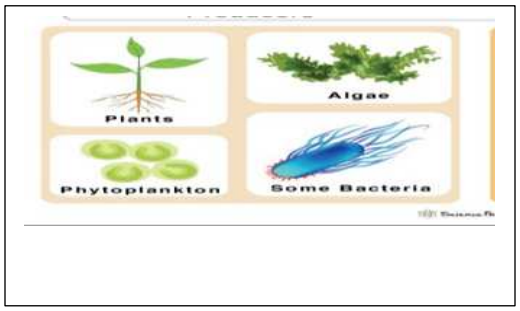
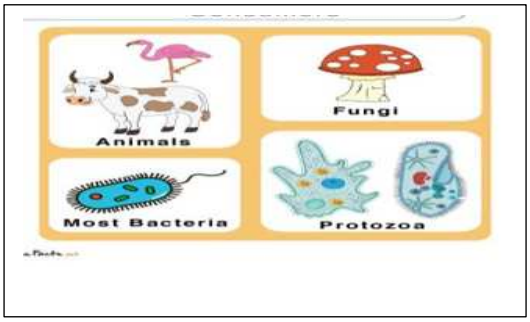
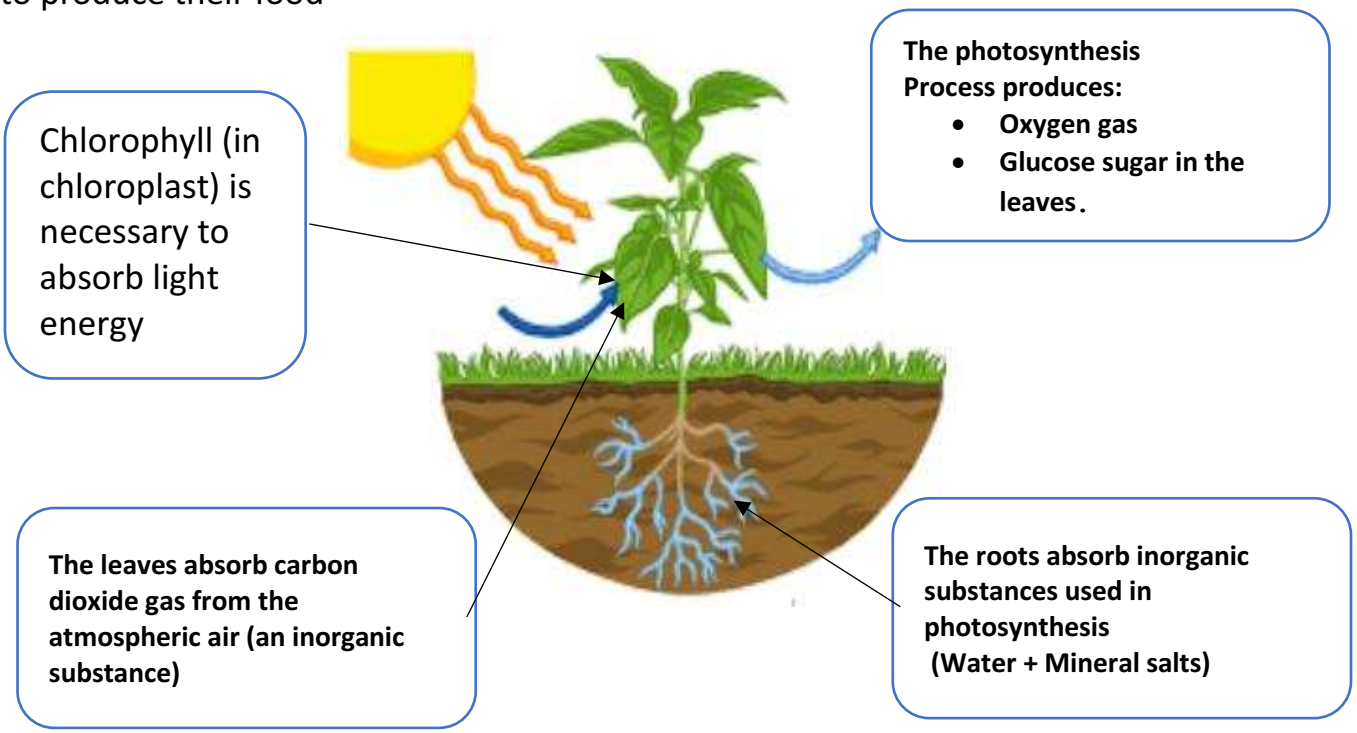
Ex:	Ex:
Prokaryotes: such as some types of bacteria **Eukaryotes:** such as plants and algae	**Prokaryotes:** such as some types of bacteria **Eukaryotes:** such as Humans and animals
	

Photosynthesis: a biological process carried out by the green leaves in the presence of light to produce their food


Chlorophyll (in chloroplast) is necessary to absorb light energy
The photosynthesis Process produces:
Oxygen gas
Glucose sugar in the leaves.
The leaves absorb carbon dioxide gas from the atmospheric air (an inorganic substance)
The roots absorb inorganic substances used in photosynthesis (Water + Mineral salts)

The equation of photosynthesis represents the conversion of light energy into stored chemical energy:

Water + Carbon dioxide+ Light energy →Glucose+ Oxygen

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The inorganic substances used in photosynthesis are:

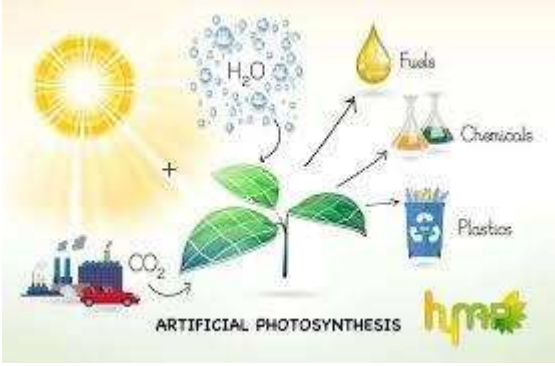
a. Water b. Mineral salts c. Carbon dioxide gas

The products of photosynthesis are:

a. Glucose (an organic substance) b. Oxygen (inorganic)

N.B <u>Energy and matter</u>

Energy and matter are two forms of the same thing, and they can be transformed into one another. Light energy is converted into stored chemical energy in the form of glucose during photosynthesis.



Artificial Photosynthesis:

Scientists have developed a technological method that mimics photosynthesis in the form of artificial leaves that resemble green plant leaves. These leaves are supplied with **hydrogen gas** and absorb carbon dioxide gas emitted from cars exhausts, factories and the power stations to produce environmentally friendly fuel, to reduce the global warming caused by the increase percentage of carbon dioxide gas in the atmosphere that leads to the elevation of Earth's temperature.

---

2) Respiration: A process by which a living organism obtains **oxygen gas** directly from its surrounding environment or through a respiratory system and release **carbon dioxide gas** during gas exchange.

a) Respiration in Unicellular Organisms

prokaryotes or **eukaryotes**, obtain oxygen gas directly from their surrounding environment and release carbon dioxide gas

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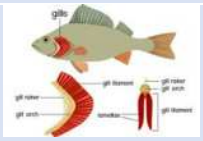
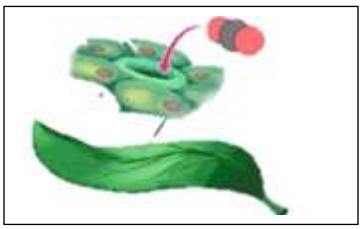
b) Respiration in Multicellular Organisms (based on their type)

Living organism	Mammals	Amphibians	Fish	Insects
Respiration method	They obtain oxygen from the atmospheric air through the respiratory organ "Lungs	They obtain oxygen from the atmospheric air and water through the respiratory organs "Lungs and skin	They obtain dissolved oxygen in water through the respiratory organ "Gills	They obtain oxygen from the atmospheric air through the respiratory organ "Tracheal tubes
Examples	**Human**	**Frog**	**Fish**	**Locust**
				

Plants: Plants do not have a specialized respiratory system, but they obtain oxygen required for respiration from the atmospheric air through natural openings on the leaves called Stomata.



They are microscopic openings in plant leaves, controlled by **guard cells** through which gases are exchanged and excess water is eliminated

Guard cells: Specialized cells that control the opening and closing of stomata in plant leaves

N.B: Some believe that plants stop respiring during the day due to photosynthesis. In reality, plants perform respiration continuously, throughout both the day and night

Both photosynthesis and respiration processes in plant are considered opposite processes? G.R

Because during photosynthesis, plant absorbs carbon dioxide gas and produce oxygen gas, while during respiration, it obtains oxygen from the atmospheric air and release carbon dioxide gas.

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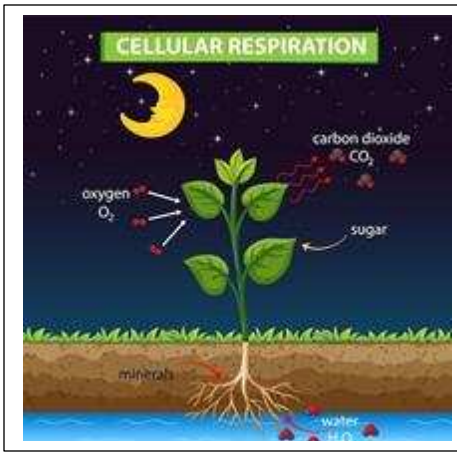
Cellular respiration: It is a vital process involves breaking down organic nutrients, especially glucose, in the presence of oxygen to release the energy required to carry out all biological activities.



Location where it occurs:

Mitochondria in the eukaryotic cells

When it occurs: Throughout the day and night.

The equation that represents it:

Glucose + Oxygen → Water + Carbon dioxide + Energy

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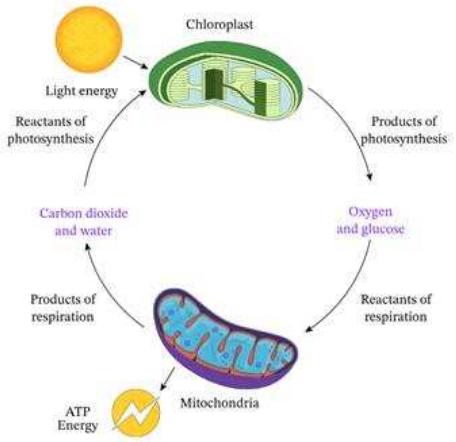
1) Chloroplasts in green plants carry out photosynthesis and produce glucose and oxygen.
2) Mitochondria use glucose and oxygen to release energy during cellular respiration , producing water and carbon dioxide, which the chloroplasts reuse in photosynthesis once again.



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3) Transportation

Eukaryotic organisms have specialized transport system for nutrients and gases, such as the circulatory system in human and the transport system in plant.

A) The circulatory system in Human:

It consists of three main parts, which are:

a- Heart
b- Blood vessels [arteries – veins – blood capillaries].
c- Blood

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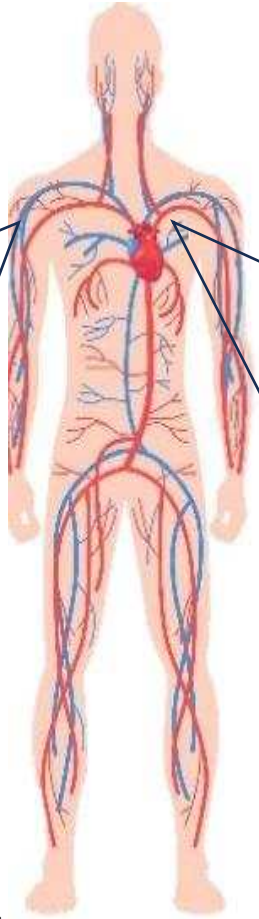
Veins

Blood vessels that carry the blood from all the body parts to the heart

Importance: Most of them carry blood containing waste products and carbon dioxide gas to the heart.



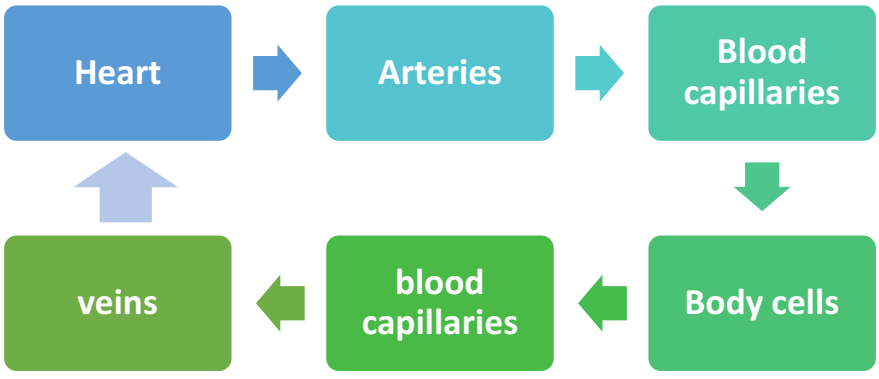
Arteries

Description: Blood vessels that carry the blood away from the heart to all the body parts.

Importance: Most of them carry blood rich in digested food and oxygen gas from the heart to all the body cells

Function:

Transport digested food and oxygen extracted from the atmospheric air through the blood. The blood carries them to the heart, that pump them to all the cells of body, and then it returns to the heart once again in a closed cycle, described as the circulation.



Blood flows in the human circulatory system in a closed cycle? G.R

Because the heart and blood vessels are connected in a continuous cycle

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B) The transport system in plant

Circulation process in human body corresponds to the process of transport in plants, which occurs through two types of tissues, which include

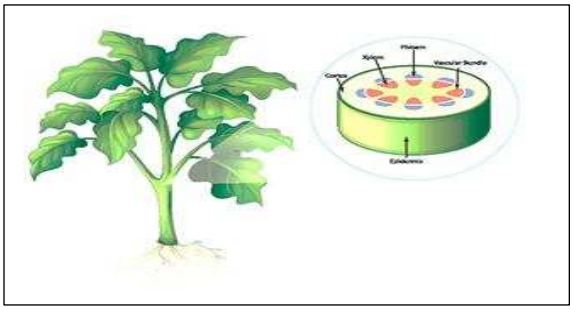
Phloem tissue

It transports the food produced by photosynthesis from the leaves to the rest of the plant.

Xylem tissue

It transports water and mineral salts from the roots to the rest of the plant until reaching the leaves.

N.B: Stem is the only organ in which water and food can move in 1 direction



4- Excretion: A process by which living organisms get rid of harmful waste products resulting from vital processes

Harmful waste products and excess substances resulting from vital processes must be eliminated from the body

A: Excretion in human:

Biological processes inside the human body produce excretory substances Including

1-Carbon dioxide gas 2-Excess water 3-Excess salts 4-Urea

Organ	Excretory substances	Way of elimination of it from the body
Lungs	Water vapor and carbon dioxide gas	Exhaled air
Kidneys	Excess water, salts and urea	In the form of urine
Sweat glands in the skin	Excess water and salts	In the form of sweat

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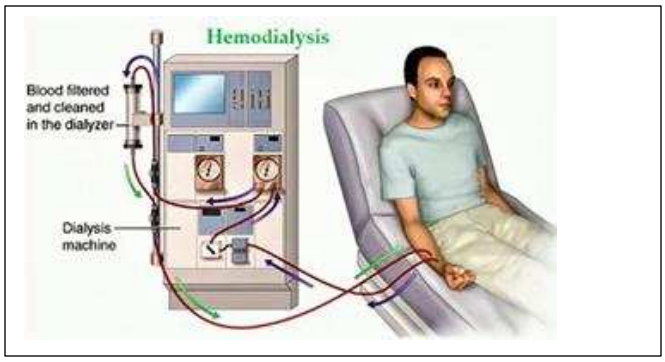
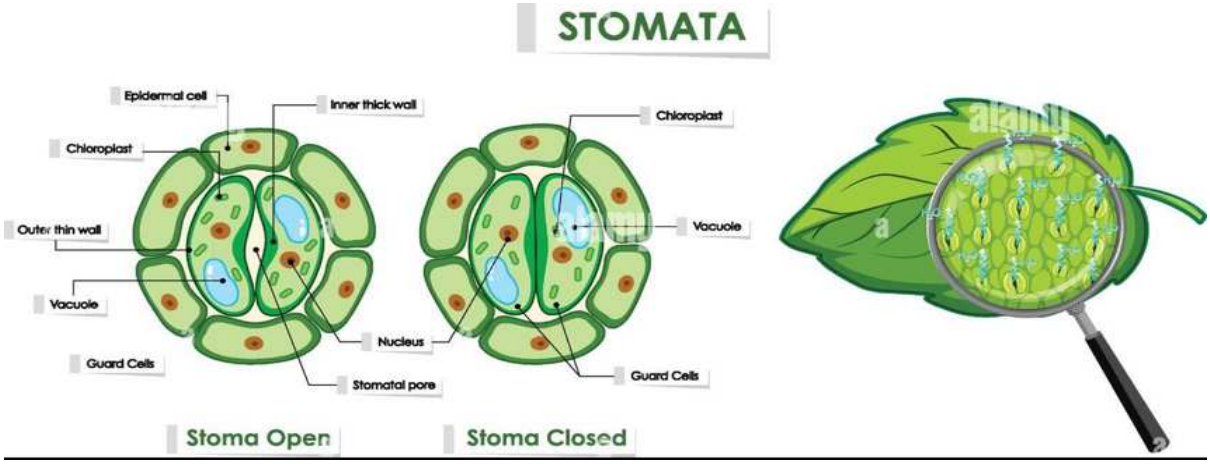
Technological application:

The dialysis machine is used for patients who suffer from kidney failure, this device performs the function of the kidneys through purifying the blood from the toxins when the kidneys stop working properly.



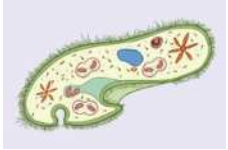
B: Excretion in plants:

Plants eliminate excess water vapor and carbon dioxide gas through minute pores called stomata, where their opening and closing are controlled by specialized cells known as guard cells.



5- Movement: The process that enables the living organism to move from one place to another

A) **Movement in Unicellular Eukaryotes:**

Living organism	**Amoeba**	**Paramecium**	**Euglena**
			
Means of movement	Pseudopodia (false feet)	Cilia	Flagellum

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B: Movement in multicellular Eukaryotes:

In human:

Musculoskeletal System: It is responsible for the movement of the human body.

In the plants:

- Plant movement is not transitional (movement to change the position and the location) like in animals, but it is limited and appears in several forms,

Such as:

- The opening of ***Gazania*** flowers during the day and closing at night.

- The drooping and folding up of ***Mimosa*** plant leaves upon touch.

- The movement of the ***Sunflowers*** to follow the movement of the sun as it rises and sets.

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Exercise

Choose the correct answer:

1. **All of the following are common general characteristics between prokaryotes and eukaryotes, except……**
   a) movement. b) nutrition. c) method of respiration. d) sensation.
2. **Which of the following living organisms differs in its nutrition method?**
   b) Beans. b) Humans. c) Cotton. d) Roses.
3. **All of the following are characteristics of consumers, except that they…….**
   a) obtain their food in a complex form.
   b)) depend directly on other living organisms.
   c) depend indirectly on other living organisms.
   d)) carry out photosynthesis.
4. **Which of the following living organisms does not have a specialized respiratory system?**
   a) Amoeba. b) Tilapia fish. c) Frog. d) Honey bee.

Give reason for each of the following:

1. **Cattle are considered consumers.**
   …….
2. **Artificial photosynthesis plays an important role in protecting the environment.**
   ……..
3. **Arteries differ from veins in the human circulatory system.**
   ……

Write the scientific term of each of the following statements:

1. **Organelles responsible for the occurrence of photosynthesis in plants.**
   (……)
2. **The substance responsible for absorbing light energy in plants.**
   (……)
3. **The substance that the plant produces as food and from which it obtains energy.** (……..)
4. **A technological method that mimics photosynthesis to produce environmentally friendly fuel.** (……)

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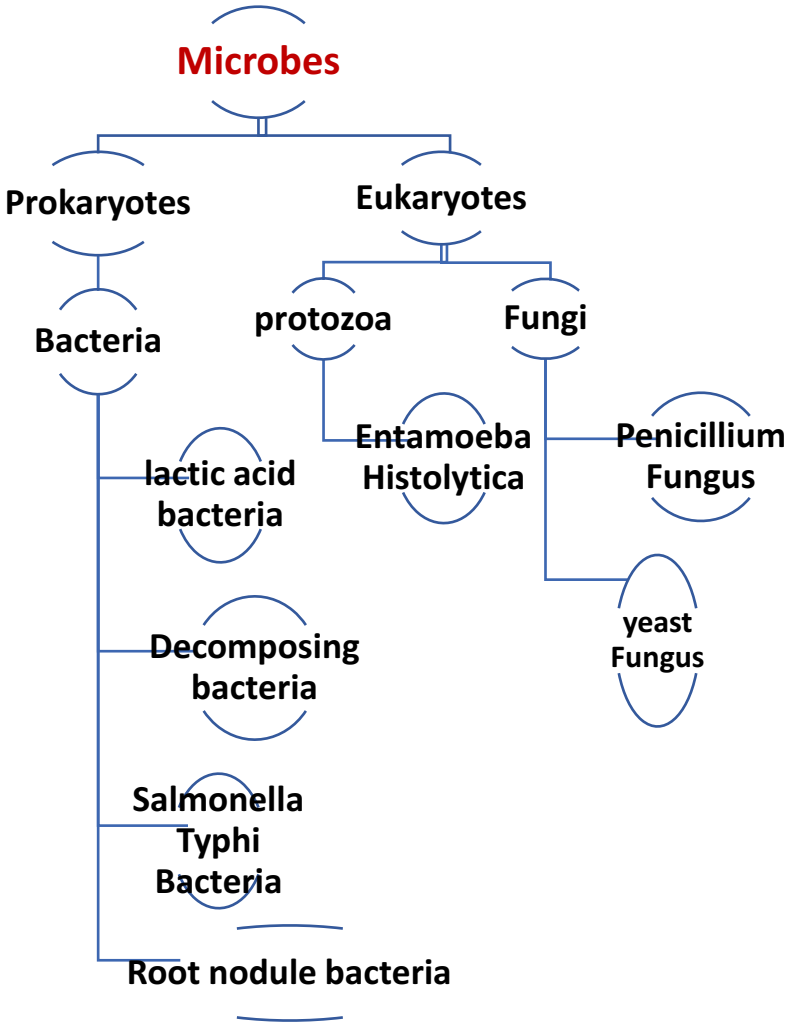
Unit 3

Lesson 3 Microbes

Microbes: Microbes are microscopic living organisms, most of them cannot be seen by the naked eye, and they are found everywhere around us including inside our bodies and they can be either beneficial or harmful.

Classification of Microbes



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First: Beneficial Microbes:

A) Beneficial bacteria:

1) **Root nodule bacteria and Decomposition bacteria.**

Green plants need:

- **Carbon, hydrogen and oxygen** elements to form carbohydrates in the process of photosynthesis.
- **Nitrogen** element to form proteins which are used in the growth of cells and tissues.

N.B Plants cannot use nitrogen from the air or the soil in its gaseous form. Therefore, certain types of beneficial microbes in the soil provide the plants with nitrogen in the form of nitrogenous compounds they can use, **such as: Root nodule bacteria**, which live on the roots of leguminous plants like **clover, beans and peas** in special structures called root nodules.

Nodule Bacteria: A type of beneficial bacteria that live inside nodules on the roots of leguminous plants, providing them with nitrogen In the form of nitrogenous compounds

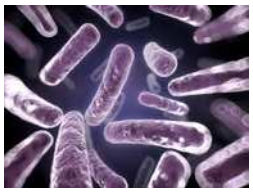
Root nodules: special structure found on the roots of leguminous plants that contain nodule bacteria that supply the plant with nitrogen in the form of nitrogenous compounds

2) **Decomposition bacteria:** The roots decompose by decomposition bacteria into nitrogenous compounds that are soluble in water, which increase the soil fertility and maintain the cycle of the necessary elements in nature.

3) **Lactic acid bacteria:**

Used in making yogurt

Yogurt is a food rich in:



- **Protein,** which is necessary for body building and muscle growth.
- **Calcium**, which is necessary for healthy bones and teeth.

Steps of making yogurt:

1- Heat one litre of milk with continuous stirring until it boils for 25 minutes…..G.R?

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To kill any bacteria that may be found in the milk.

2- Let the milk cool down to warm (at a temperature of 42°C).

3- Add half a cup of previously prepared yogurt to the milk... G.R?

Because the previously prepared yogurt contains lactic acid bacteria

4- Pour the milk into suitable containers and leave them in a warm place (at a temperature of 35°C to 45°C) for 4 to 5 hours G.R?

To be suitable for bacterial growth to complete the fermentation of the milk, causing the milk curdles (be thicker) and change its taste into the distinctive sour taste of yogurt.

5- Put the yogurt containers in the refrigerator until it is used... G.R.?

To stop the activity of lactic acid bacteria

Lactic acid bacteria convert lactose (milk sugar) into lactic acid, which gives yogurt its distinctive sour taste and thickness.(Milk fermentation)

Milk curdling: convert milk from a liquid to a semi-solid state by lactic acid bacteria

Keeping yogurt out of the refrigerator?

The activity of lactic acid bacteria will continue, producing more lactic acid, which increases the yogurt acidity and spoils its taste.

Life Application

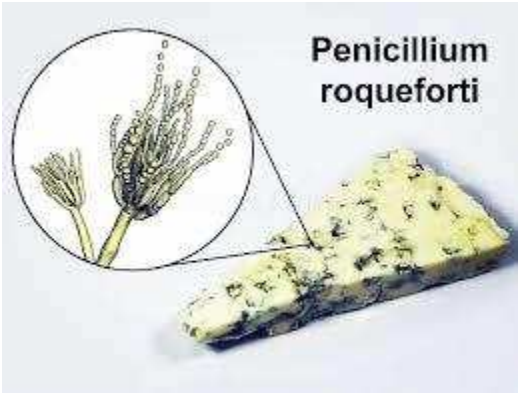
Some mothers, during making pickled olives, add a spoonful of sugar to the salt solution used ... G.R.?

To reduce the bitterness of the olives and improve the taste, as sugar acts as a food source for beneficial bacteria, which convert the sugar into lactic acid.

B) Beneficial Fungi:

1) Penicillium Fungi

I- *Penicillium Roqueforti* fungus:
Used in making roquefort cheese, responsible for its distinctive taste and various colors.



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II- *Penicillium Notatum fungus*

•Discovered by the English scientist **Alexander Fleming** in 1928, who found that ***Penicillium Notatum*** secretes a substance that stops the growth and reproduction of a certain type of bacteria.

•Fleming extracted from this substance the well-known antibiotic which is called "**penicillin**" - named after the ***Penicillium*** **fungus** - it is used to kill bacteria that cause some diseases such as **diphtheria and tonsillitis.**

---

2) Yeast fungus:

- It is a source of vitamin (B) complex
- Rich in antioxidants.
- It is used in making bread and ethyl alcohol (ethanol) production.

Second: Harmful Microbes

Harmful microbes can enter the human body through:

- Breathing
- Eating contaminated food
- Penetration of the skin and reach the bloodstream

Some Diseases Caused by Food Contamination

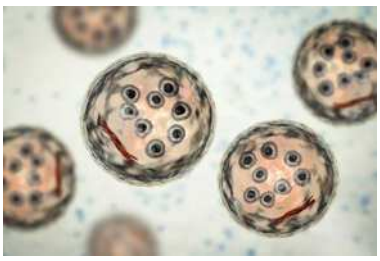
1- Dysentery (Amoebic dysentery)

- **Disease causing agent (pathogen):**

A unicellular protozoan known as ***Entamoeba Histolytica,*** which lives in the patient's large intestine

- **How the disease is transmitted:**

Eating food contaminated with the microbe.



- **Symptoms:**

1. Repeated (frequent) bloody diarrhea.
2. Stomach pain.
3. Loss of appetite.
4. Weight loss.
5. Continuous fatigue

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- **Treatment:**

Using antiprotozoal drugs

2- Typhoid disease:

- **Disease causing agent (pathogen):**

•A type of bacteria called ***Salmonella Typhi,*** which infects the human digestive tract, thus it is a bacterial disease.

- **How the disease is transmitted:**

•Eating food or drinking water contaminated with *Salmonella Typhi.*

- **Symptoms:**

1. High fever (the body temperature can reach 40°C).
2. Fatigue.
3. Headache.
4. Stomach and muscle pain.
5. Flatulence.

- **Treatment**:

Using antibiotics

4)

Some Healthy Habits for Disease Prevention
There are healthy habits that should be followed for the prevention of many diseases, including:
1
Washing vegetables and fruits thoroughly before eating
2
Not leaving food uncovered to protect it from contamination
3
Washing hands before eating and after using the bathroom
4
Brushing teeth with a personal toothbrush after meals
5
Drinking at least 3 liters of pure water daily

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Exercise

Choose the correct answer:

1. **Which of the following is a leguminous plant?**
   a) Wheat. b) Peas. C) Rice. d) Com.
2. **Which of the following elements is absorbed by nodular bacteria from the soil?**
   a)Carbon. b) Hydrogen. c) Oxygen. d) Nitrogen
3. **How do bacteria convert milk into yogurt?**
   a) By producing ethyl alcohol c) By producing lactic acid.
   b) By producing carbon dioxide gas CO_2 d) By producing lactose sugar.
4. **All the following are classified as microbes that belong to prokaryotes or eukaryotes, except……..**
   bacteria. b) fungi. c) viruses. d) protozoa

Write the scientific term of each of the following statements:

1. **Plants that is unable to utilize nitrogen from the air or soil in its gaseous form.**
   (……)
2. **A type of bacteria that lives inside nodules found on the roots of certain plants.** (……)
3. **A type of bacteria that provides nitrogen to the bean plant in the form of usable compounds.** (……)
4. **A type of bacteria that increases soil fertility and maintains the cycle of elements in nature.** (……)

Give reasons for each of the following:

1. **Milk is boiled thoroughly for a sufficient period during making yogurt.**
   ……..
2. **After harvesting leguminous plants, farmers leave their roots in the soil.**
   ……
3. **Some mothers add a spoonful of sugar to the salt solution during making pickled olives.**
   ……

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Unit 4

Lesson 1 The Earth and solar system

The solar system consists of:

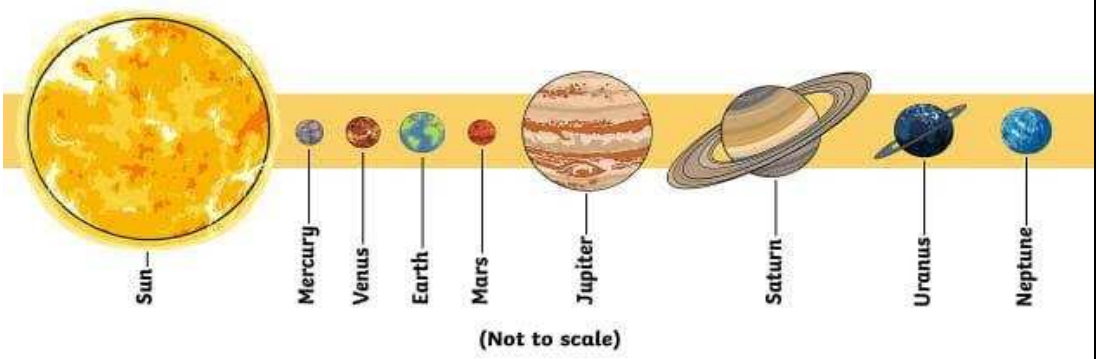
One star, the sun, which 8 planets orbit in Elliptical paths at different distance from the sun

The planets do not collide during orbiting the sun? G.R

Because They orbit the sun in elliptical paths at different distances from the sun.

Arrangement of the planets according to:

1. **Distance from the sun:** The planets of the solar system are arranged in ascending order according to the distance from the sun (from the closest to farthest) as follows:



2. **Diameter:** The planets of the solar system are arranged in ascending order according to their diameters (from the smallest to largest) as follows:

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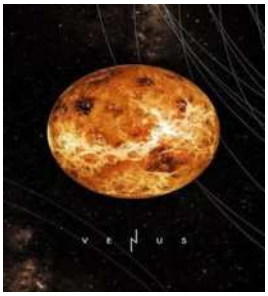
Classification of the planets

The planets of the solar system are classified into two groups based on their distances from the sun:

Inert Planets The four closest planets to the sun which are :				
Composition: Rocky planets	 **Mercury** Has a very thin crust filled with craters caused by meteor impacts	 **Venus** Has a thick crust compared to Mercury's crust	 **Earth** Has a thicker crust than Venus	 **Mars** Has a thick crust relatively similar to Earth's crust, it is known as the red planet.
The atmosphere:	Very thin composed of H_2 and He gases.	Very dense, composed mainly of CO_2	Composed mainly of N_2 and O_2 gases where it is the planet of human life	Composed mainly of CO_2
The volcanic activity:	No active volcanoes	Many active volcanoes	Many active volcanoes	There are indications of volcanoes but no current volcanic activity

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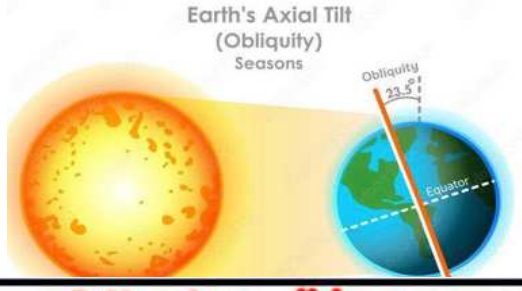
Outer Planets The four farthest planets from the sun which are :		
Composition: Rocky planets	 Gases planets : Composed of gases only, they have no crust	 Gases planets: Composed of gases and ice, they have no crust.
The atmosphere:	Composed of H_2 and He gases.	Composed of H_2 and He gases, in addition to methane gas which gives: • **Uranus** a greenish blue color. • **Neptune** is known as the blue planet.
The volcanic activity:	No volcanoes	No volcanoes

What is the order of ? **Earth planet in the term of :**
1. **Distance from the sun.** • **Third order**
2. **Size "in ascending order.** • **Fourth order**
3. **Size " in descending order.** • **Fifth order**

The Sun- Earth System

1 Earth's Rotation on its Axis:

The Earth rotates around its imaginary axis from west to east it completes a full rotation every 24 hours around its axis.



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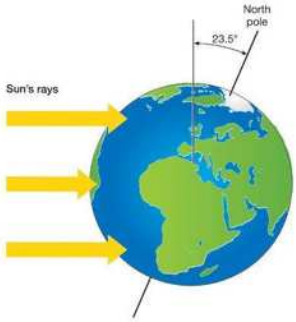
Earth's Axis: It is an imaginary straight line extending from the **North Pole** to the **South Pole**, passing through Earth's center, it tilts at an angle of **23.50** from the imaginary perpendicular line to its orbit around the sun.

What is the result of the tilt of the Earth's axis?

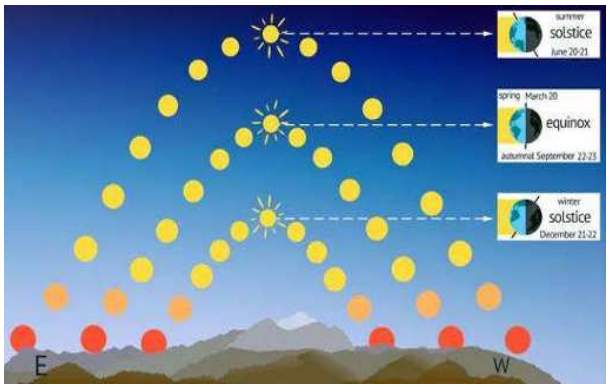


This results in the variation of the angle at which sunlight falls on the different areas of Earth's surface, leading to differences in the intensity of sunlight falling on the unit area.

The rotation of the Earth around its axis in front of the sun causes:

- The alternation of day and night (Day and night cycle).
- The apparent motion of the sun.

The Apparent Motion of the Sun



While the Earth rotates on Its axis **from** west to east, the Sun appears in the sky throughout the day or the year as if its **position is shifting** from east to west, a phenomenon called the apparent motion of the Sun.

The Apparent Motion of the Sun: The Sun's appearance in the sky throughout the day or the year as if its position is changes from east to west while the Earth rotates around its own axis.

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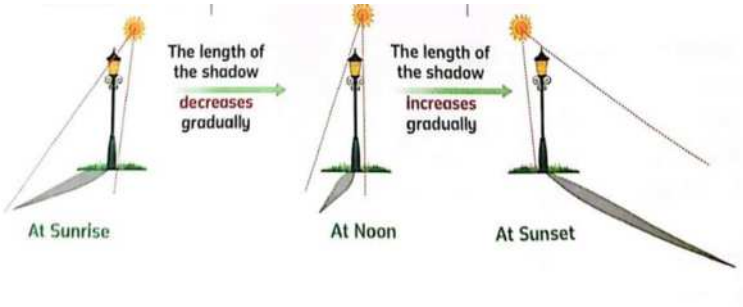
The Sun's apparent height varies throughout the day, as follows:

	At the period between sunrise and noon	At noon	At the period between noon and sunset
The Sun's apparent height	The apparent height of the Sun increases gradually	The Sun's apparent height reaches its highest point	The Sun's apparent height decreases gradually
The length of the shadows cast by objects changes throughout the day as follows:	The length of the shadow is long at sunrise	The shadow is the shortest at the noon	The shadow is the longest at sunset

the length of an object's shadow is...

- **long at sunrise and sunset.**
- **the shortest at noon.**
- **longer at sunset than at sunrise.**

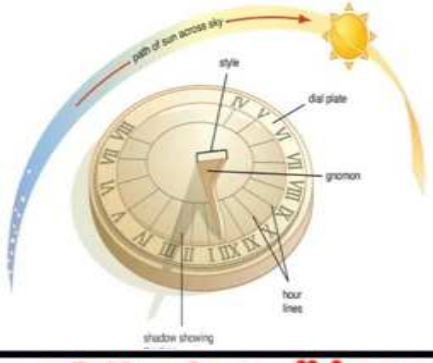


The shadow length at noon is the shortest. G,R

Because the Sun's apparent height is at its maximum at that time

Technological Application

Sundial: An ancient solar clock that was used to determine the time and direction of the shadow resulting from the motion of the Sun based on the length apparent motion of the Sun



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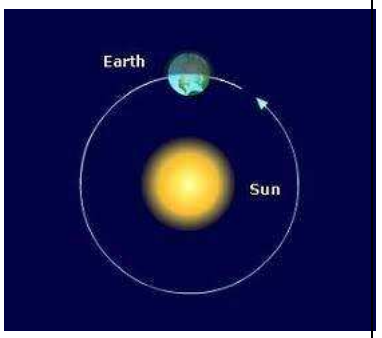
Earth's orbit around the sun

The Earth orbits around the Sun every 365 ¼ days.

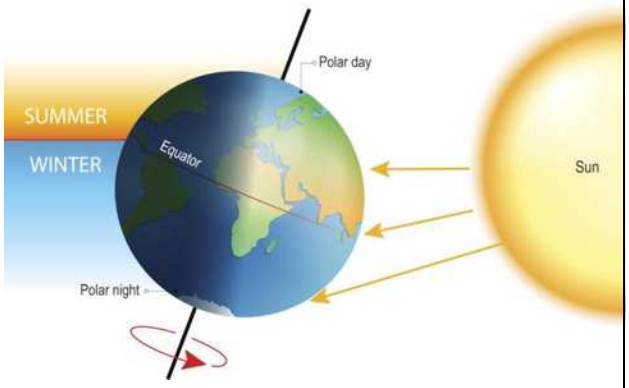


This results in:

The alternation of the four seasons (The cycle of the seasons)

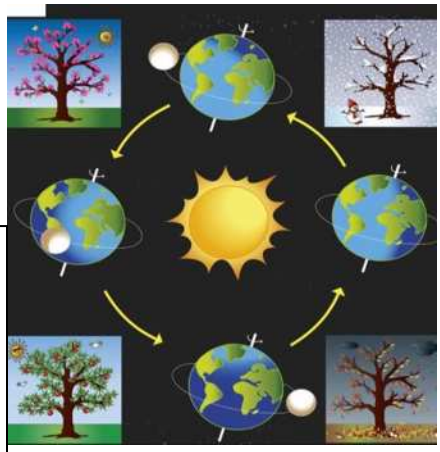
The cycle of the Seasons

The tilt of Earth's axis and its orbit around the sun cause sunlight to fall on the Earth's surface at different angles, leading to variations in the amount of sunlight received by Earth's hemispheres (the two halves of Earth's sphere) throughout the year, this results in the alternation of the four seasons across 365 ¼ days.



The relation between the Earth's axis direction relative to the Sun and the four seasons:

_The four seasons vary depending on the direction of the leaning of the northern end of the Earth's axis relative to the Sun at different times of the year,



Vernal-(spring)-Equinox

Occurs on March 21st

The northern end of the earth's axis neither leans close to nor away from the sun

Summer Solstice

Occurs on June 21st

The northern end of the Earth's axis leans closest to the sun (at an angle of 23.5°)

Winter-Solstice

Occurs on December 22nd

The northern end of the Earth's axis leans away from the sun (at an angle of 23.5°)

Autumnal Equinox

Occurs on September 23rd

The northern end of the Earth's axis neither leans close to nor away from the sun

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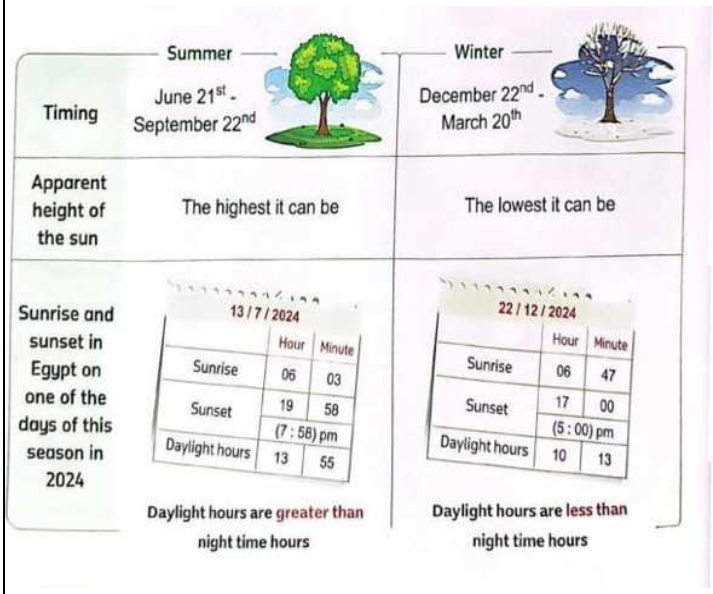
The difference in the direction of the tilt of the Earth's axis results in variations in the daylight and night hours throughout the seasons, leading to changes in weather conditions, below:



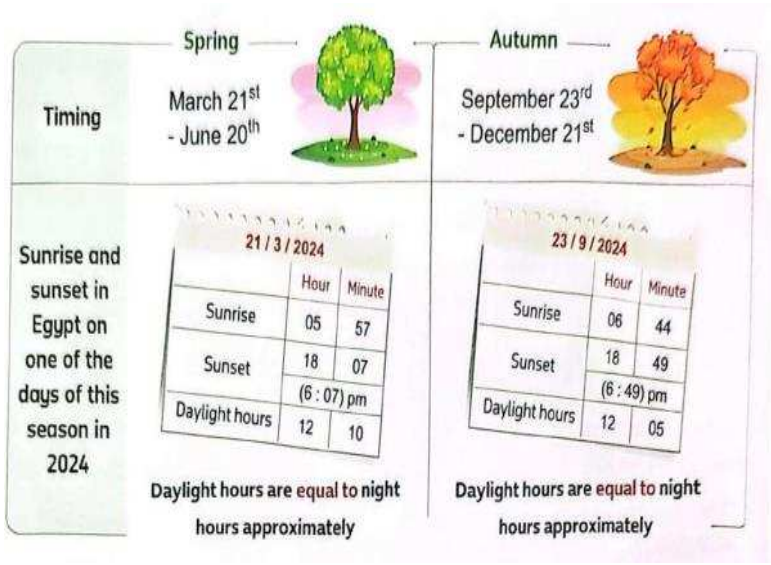
Timing	Summer: June 21st - September 22nd	Winter: December 22nd - March 20th
Apparent height of the sun	The highest it can be	The lowest it can be
Sunrise and sunset in Egypt on one of the days of this season in 2024	13 / 7 / 2024	22 / 12 / 2024

13 / 7 / 2024	Hour	Minute
Sunrise	06	03
Sunset	19	58
	(7 : 58) pm	
Daylight hours	13	55

Daylight hours are greater than night time hours

22 / 12 / 2024	Hour	Minute
Sunrise	06	47
Sunset	17	00
	(5 : 00) pm	
Daylight hours	10	13

Daylight hours are less than night time hours



Timing	Spring: March 21st - June 20th	Autumn: September 23rd - December 21st
Sunrise and sunset in Egypt on one of the days of this season in 2024	21 / 3 / 2024	23 / 9 / 2024

21 / 3 / 2024	Hour	Minute
Sunrise	05	57
Sunset	18	07
	(6 : 07) pm	
Daylight hours	12	10

Daylight hours are equal to night hours approximately

23 / 9 / 2024	Hour	Minute
Sunrise	06	44
Sunset	18	49
	(6 : 49) pm	
Daylight hours	12	05

Daylight hours are equal to night hours approximately

*The alternation of the four season's follows specific patterns can be observed throughout the year, leading to changes in weather, temperature and the day length.

**The seasons also affect the times of planting and harvesting the different crops in Egypt, as follows:

Summer Crops	Winter crops
Watermelon	Orange
Cucumber	Lettuce
Onion	Wheat
Zucchini	Clover

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Exercise

Choose the correct answer:

1. **The solar system contains…….**
   a) eight stars. b) thousands of stars.
   b) millions of stars. d) one star.
2. **The farthest rocky planet from the Sun is……**
   a) Neptune. b) Earth. c) Mercury. d) Mars.
3. **Earth is the…… planet from the sun.**
   a) third b) fourth c) fifth d) sixth
4. **The main component of the atmosphere of Mars and Venus is……. gas.**
   a)hydrogen b) helium c)methane d) carbon dioxide

Give reasons for each of the following:

1. **Gaseous planets do not have volcanoes.**
   ……
2. **The succession of day and night on Earth's surface.**
   ……
3. **The length of a shadow at noon is the shortest.**
   ……
4. **The alternation of the four seasons.**
   ……

Write the scientific term of each of the following statements:

1. **An imaginary straight line extending from the North Pole to the South Pole passing through Earth's center.** (……..)
2. **The appearance of the sun in the sky throughout the day or the year as if its position is shifting from east to west while the Earth rotates around its own axis.**
   (……)
3. **Rocky planets with solid surfaces.** (……)

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Unit 4

Lesson 2 **lunar Eclipse**

Lunar Eclipse

The moon is a dark (opaque) body that orbits the Earth

Its rotation around its own axis also takes 29.5 days

It is the closest celestial body to the Earth

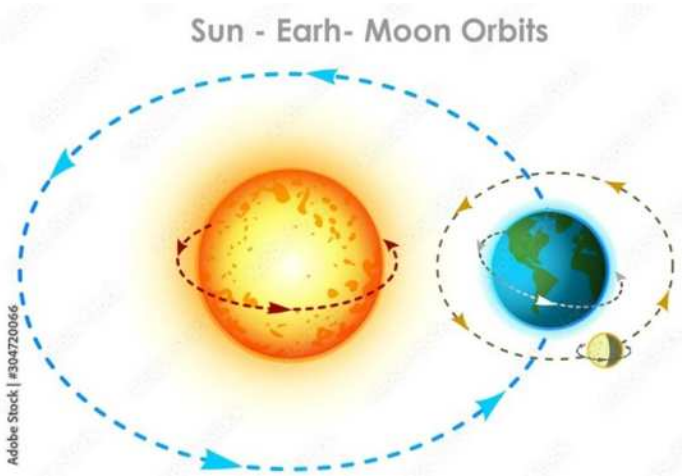
It appears illuminated as the result of reflect sunlight

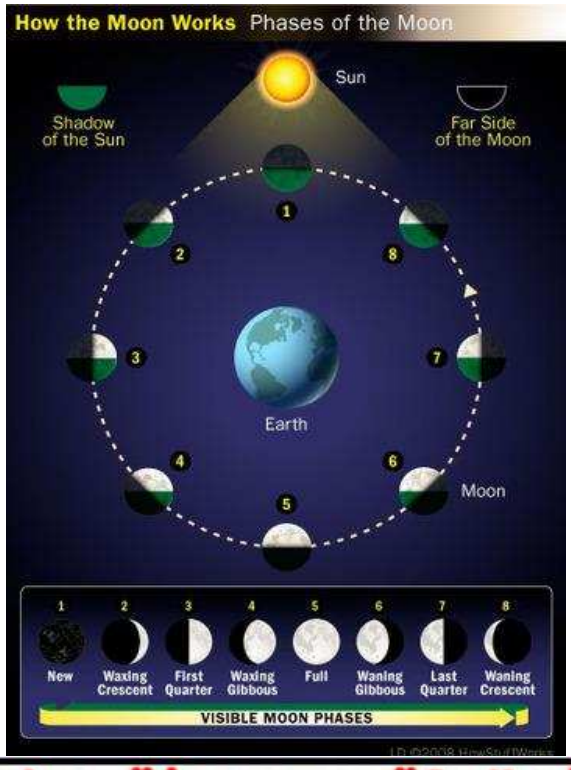
Its revolution around the Earth takes 29.5 days

What are the consequences of ?

Time of a complete orbit of the moon around the earth is the same time of its complete rotation around its axis.

The observers on Earth always see one side of the moon.





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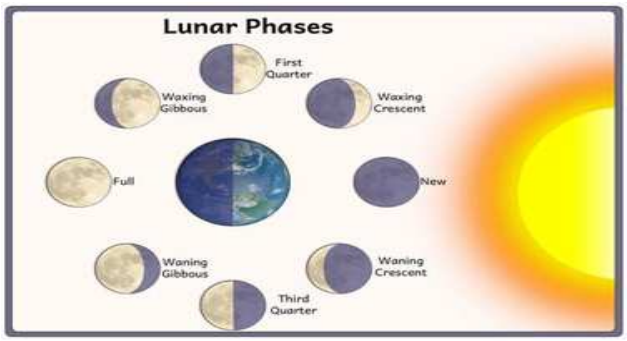
Moon Phases

The moon appears to change shape throughout the Arabic (lunar) month**, <u>but it doesn't actually change</u>**. In fact, what changes is the size of the part of the moon that can be seen from the **<u>illuminated part</u>** that reflects sunlight.

The moon orbits the Earth from **east to west**, so <u>its position</u> relative to both the sun and the Earth <u>changes,</u> leading to <u>eight</u> phases known as **<u>the phases of the moon</u>**.

(They are the different stages that the moon goes through during its orbit around the Earth as a result of the changing of its position relative to both the sun and the Earth.)



The moon phases can be divided into two periods:

1) **First Half of the Lunar (Arabic) Month:** The eastern illuminated part of the moon's side which faces the earth increases day by day as follows:

Moon's Visibility Time	Percentage of the Moon's Orbit	Name of the Phase	Appearance of the Moon	
Beginning of the lunar month	1/8 of Moon's orbit	First (waxing) Crescent	A small part of the side of the moon is illuminated on the right side	
After 7 days weekend	2/8 or ¼ of Moon's orbit	First Quarter	Half the side of the moon is illuminated on the right side	
On the 11th day	3/8 of Moon's orbit	Waxing Gibbous	¾ of the side of the moon is illuminated on the right side	
After 14 days (the middle of the lunar month)	4/8 or ½ of Moon's orbit (when the earth lies between the moon and Sun	Full Moon (Second Quarter)	The moon's side which faces the earth is completely illuminated (It appears as a complete bright disc)	

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2) Second Half of the Lunar Month:

Moon's Visibility Time	Percentage of the Moon's Orbit	Name of the Phase	Appearance of the Moon	
After 17 days	5/8 of Moon's orbit	Wanning Gibbous	¾ of the side of the moon is illuminated on the left side	
After 21 days (third weekend)	6/8 or ¾ of Moon's orbit	Last (Third) Quarter	Half the side of the moon is illuminated on the left side	
After 26 days	7/8 of Moon's orbit	Second Crescent	A small part of the side of the moon is illuminated on the left side	
End of Lunar month	Full Moon's orbit (The moon lies between the Sun and the Earth)	New Moon	The moon's side which faces the Earth is completely dark (Opaque disc)	

What Happens When..?

the Earth is positioned between the Sun and the moon in the middle of the lunar month?

The moon appears as a complete bright disc, this phase is called the full moon phase.

Lunar Eclipse:

A natural phenomenon that occurs when the earth, during its orbit around the Sun, is located on the line between the Sun and the moon, and so it blocks sunlight partially or completely from reaching the moon

It is noticed once or twice a year that the moon in its full moon phase disappears gradually out of slight, this is called (**Lunar eclipse)**

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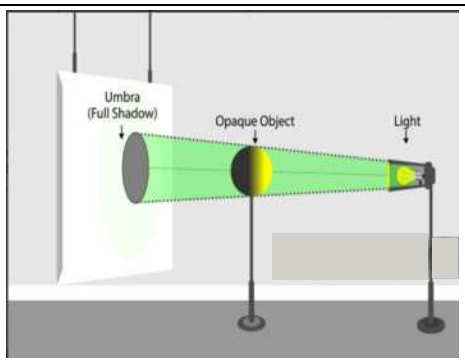
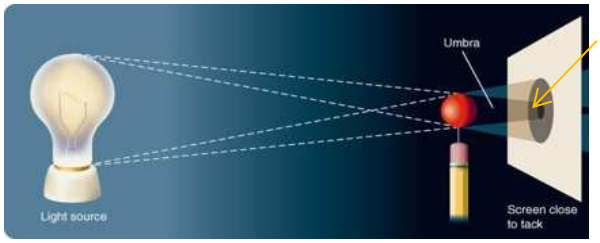


The formation of Shadow (umbra) and penumbra:

The dark area: is the shadow (umbra) of the ball

The partially lit area (surrounding the shadow of the ball) is the penumbra of the ball.



Shadow (umbra)

The dark area that does not receive light as a result of the presence of an opaque object in the path of the light rays

Penumbra

The partially illuminated area that receives some of the light rays, which surrounds the shadow created by the presence of an opaque object in the path of light rays

Transparent object: Object that allows the light to pass through it, thus no shadow is formed.

Opaque object: Object that does not allow the light to pass through it, thus a shadow is formed.

Even though an object is in the path of light rays, no shadow is formed on a screen placed in front of it.

Because it is a transparent object that allows the light to pass through it, so no shadow is formed.

Lunar eclipse does not occur every time the moon is in full moon phase.

Because the moon's orbit around Earth is tilted about 5 degree relative to the earth's orbit around the Sun, so the moon is not always align between the Sun and I the Earth during every full moon.

Types of lunar Eclipse

1) Total lunar eclipse

2) Partial lunar eclipse.

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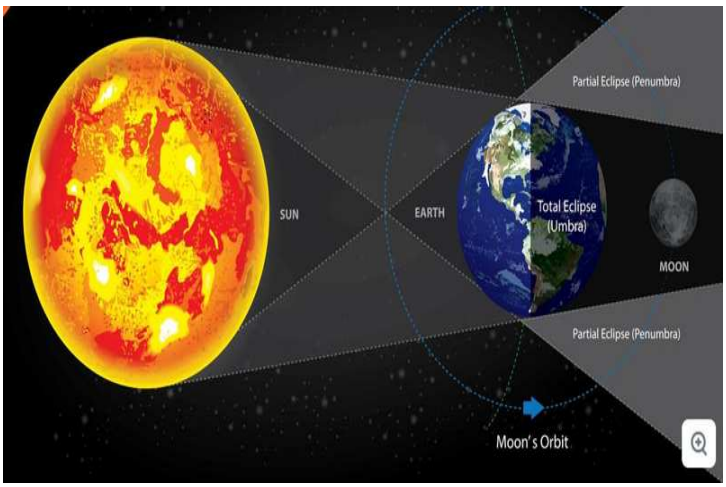
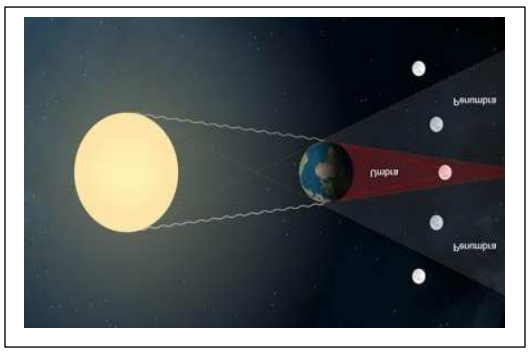
Eclipse	Total lunar eclipse	Partial lunar eclipse
Location of the moon	The entire moon is located within the shadow of the earth	A part of the moon's body is located within the shadow of the earth, while the other part is in the penumbra of the earth
Appearance of the moon	The moon appears as a dark disc due to the absence of sunlight	The moon appears partially dark.

N.B:

When the whole moon is located completely within the penumbra of Earth it appears as a dimly lit **Red disc**, and this is not considered an **Eclipse**





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Exercise

Choose the correct answer:

1. **The moon takes approximately ……..to complete its orbit around the Earth.**
   a) 23.5 days b) 24 hours c) 88 days d) 29.5 days
2. **The number of phases that the moon goes through during the lunar month is……phases.**
   a) 6 b) 8 c)9 d) 7
3. The moon is in the……. phase when the right half of its side is illuminated.
   a) waxing crescent c) wanning crescent
   b) first quarter d) last quarter
4. **The phases of the moon occur during the lunar month as a result of……..**
   a) the Sun orbiting around the moon.
   b) the moon orbiting around the Sun.
   c) the earth orbiting around the moon.
   d) the moon orbiting around the Earth.

Give reasons for each of the following:

1. The moon is called the first quarter at the end of the first week of the arabic month.
   ……..
2. The moon cannot be seen during the new moon phase.
   ……
3. The moon cannot be seen at the end of the lunar month.
   ……
4. A lunar eclipse does not occur during every full moon.
   ……..
5. The moon disappears during the total eclipse.
   ……

Write the scientific term of each of the following statements:

1) The phase in which the right half of the moon's side is illuminated
   (……)
2) An opaque body orbiting the Earth and is the closest celestial body to it.
   (……)

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